United States Patent [19]

Schare

[11] **3,900,624**

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[54] **STATIC CHARGE RESISTANT SYNTHETIC YARNS**

[76] Inventor: **Walter G. Schare,** Forge Hollow, Lakeville, Conn. 06039

[*] Notice: The portion of the term of this patent subsequent to Dec. 11, 1990, has been disclaimed.

[22] Filed: **July 10, 1973**

[21] Appl. No.: **377,968**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 187,082, Oct. 6, 1971, Pat. No. 3,778,331.

[52] **U.S. Cl.** **428/97;** 57/144; 57/149; 57/162; 338/208; 428/370; 428/371; 428/377; 428/922

[51] **Int. Cl.**.. **A47g 27/02;** B32b 15/08; B32b 27/34

[58] **Field of Search** 161/62–67, 161/175, 176, 214, 216; 57/144, 149, 162; 338/208

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Primary Examiner—Harold Ansher

[57] **ABSTRACT**

A static-charge resistant yarn constituted by a ribbon having rough or abraded faces which are vacuum-plated with tin or other non-oxidizing metal that impregnates the ribbon to create a non-reflective, electrically conductive, static discharge path. The metal-plated ribbon is twisted, texturized or wrapped about a filamentary core to form a metallized textile yarn which is intermixed with conventional yarns and woven, tufted or otherwise processed to create textile fabrics for clothing and coverings or for carpets and rugs.

6 Claims, 4 Drawing Figures

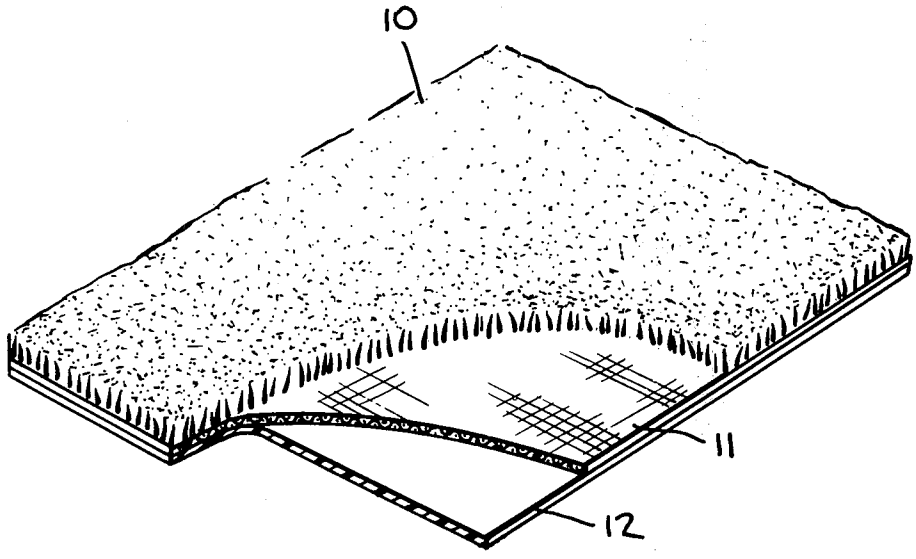
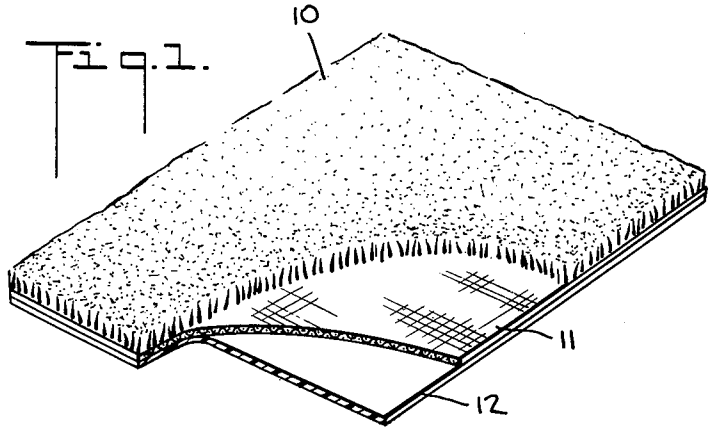


Fig. 1.



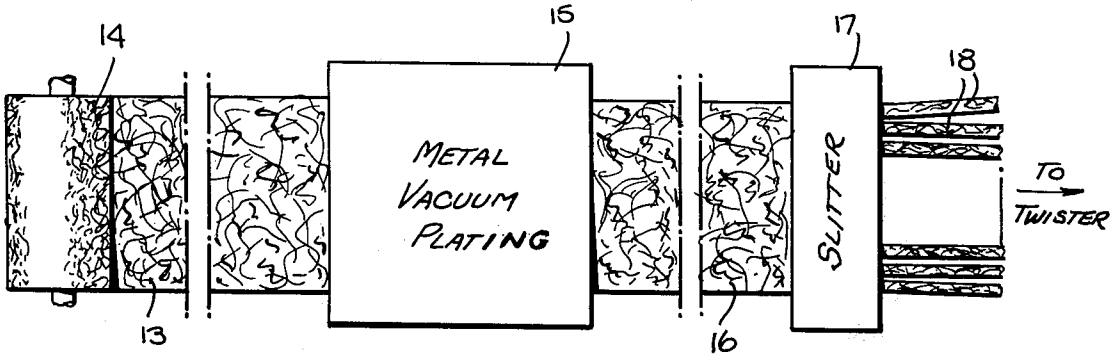
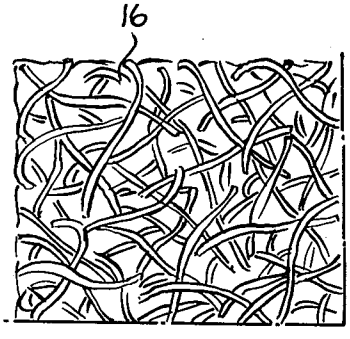


Fig. 2.

Fig. 3.



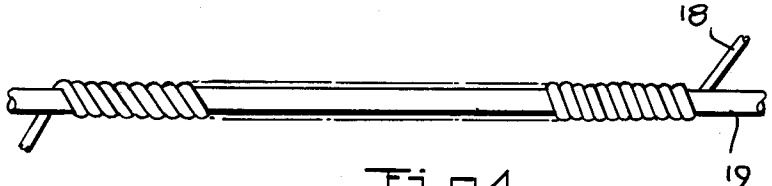


Fig. 4.

STATIC CHARGE RESISTANT SYNTHETIC YARNS

RELATED APPLICATION

This application is a continuation-in-part of the co-pending application Ser. No. 187,082 filed Oct. 6, 1971 having the same title now U.S. Pat. No. 3,778,331.

BACKGROUND OF THE INVENTION

This invention relates generally to textile fabrics, rugs and carpets, fabricated of synthetic plastic yarns, and more particularly to products of this type which have anti-static properties.

The introduction of synthetic fibers into floor coverings is of fairly recent origin, for until about 25 years ago, wool was considered the only suitable component for carpet pile. Wool, being a natural fiber, is very heterogeneous with respect to color, denier, impurities and processing characteristics.

By using synthetic fibers in place of wool in rugs and carpets, one is able to take advantage of the uniform mechanical and chemical properties of a variety of commercially-produced synthetic plastic yarn materials such as Nylon, Orlon, Zefran and Acrilan. However, while existing floor coverings fabricated of such synthetic fibers are durable, relatively easy to manufacture, and available at low cost in a great range of styles and colors, they all suffer from one serious drawback, namely, static.

As is well known, all solids other than metals acquire an electrostatic charge when rubbed with some other substance. The charge accumulated by the material depends on its inherent dielectric properties and also on its relative dryness, for while a piece of dry paper may be readily charged, the paper will not sustain a charge when in the damp state.

In the case of the floor coverings made of synthetic fibers, static is particularly bothersome, for synthetic fibers are hydrophobic by nature, so that one treading over a rug will produce sufficient friction to develop a substantial electrostatic charge, particularly under low humidity conditions. Consequently, should the rug-walker touch or otherwise make contact with a conductive member, such as a door handle, the accumulated static charge will suddenly be discharged. This discharge in some instances is accompanied by a visible spark.

The static characteristics of conventional floor coverings fabricated of synthetic yarn often lead to disturbing and unsettling experiences and are a source of annoyance and discomfort in households and offices. In addition, in certain environments, such as hospitals and controlled industrial environments, such static discharges may be hazardous. The static-acquiring properties of synthetic yarns is also bothersome in clothing made of synthetic fabrics such as nylon.

Various attempts have heretofore been made to render textiles and carpets static-charge resistant. Thus it has been proposed to incorporate in the surface of a carpet a small quantity of stainless steel fiber in staple form (Modern Textile Magazine June 1967, pages 53–56). Copper wire of fine denier has been added to nylon carpets for the same purpose. U.S. Pat. No. 2,302,003 suggests the incorporation of an electrically conductive cord in the pile fabrics. The use of metal wires in pile fabrics is disclosed in U.S. Pat. Nos. 2,385,577 and 2,508,852. U.S. Pat. No. 3,582,444 discloses pile loops for fabrics incorporating metallic laminate thread.

One difficulty encountered with prior art mixtures constituted by metal wires or threads with synthetic fibers is that because the yarn components of the mixture are dissimilar, problems arise in connection with their mixing and processing as well as the hand of the products obtained thereby. But a most important drawback arises from the fact that wires and threads tend to glitter, and even when only a relatively small amount of metal is used, its presence is clearly perceptible to the viewer. This is undesirable from the decorative standpoint.

In choosing a rug or carpet, one ordinarily selects a color in harmony with the dominant wall color of the room for which the carpet is intended. If the carpet contains metallic threads, their glitter introduces a decorative element which may not be in keeping with the decor. Hence though metallic threads solve the problem of static charges, they in many instances render the product unacceptable.

SUMMARY OF THE INVENTION

In view of the foregoing the main object of this invention is to provide static-charge resistant metallized yarns which are non-reflective and which may be incorporated in clothing fabrics, rugs, carpets and other textile products without imparting a metallic glitter thereto.

More specifically it is an object of the invention to provide a non-reflective metallized yarn formed preferably of nylon, which yarn may be intermixed with conventional yarns and which lends itself to dyeing and other processing operations.

Also an object of the invention is to provide a low-cost non-reflecting paper yarn of high wet strength capable of being incorporated in yarn products whose appearance and decorative qualities are indistinguishable from products lacking the paper yarn whereby the metallized yarn may be combined readily with non-metallized yarns.

Yet another object of the invention is to provide a non-reflecting yarn formed of synthetic films whose faces are roughened or abraded and subsequently metal plated to produce a metallized yarn having a matte finish.

Briefly stated, these objects are accomplished by vacuum plating the opposing faces of a web formed of a synthetic material having a rough or abraded surface with a non-oxidizing metal such as tin to impart a matte, non-reflective finish thereon, which metallized web is no more difficult to dye than pure nylon or other non-metallized fibers. The metallized web is then slit into ribbons which are thereafter twisted, texturized or wrapped about a filamentary core to provide metallized yarns having non-reflecting electrically conducting paths. These metallized yarns are then intermixed with conventional yarns and woven, tufted, braided or otherwise processed to create textile fabrics for clothing and coverings and for carpets and rugs.

OUTLINE OF THE DRAWING

For a better understanding of the invention, as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawing, in which:

FIG. 1 is a perspective view of a tufted carpet in accordance with the invention;

FIG. 2 is a schematic diagram of a system for producing static-resistant metallized yarns to be used in fabrics, floor coverings and other products in accordance with the invention;

FIG. 3 is a magnified piece of non-woven nylon paper;

FIG. 4 is an enlarged view of a single static-resistant yarn produced by the system shown in FIG. 2.

DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, there is shown a tufted carpet of conventional construction, constituted by cut pile yarns **10**, tufted into a woven backing **11** and anchored thereto by a latex base layer **12**. The significant feature of the invention is that the pile yarns **10** are constituted by conventional pure nylon yarns which may be texturized to impart bulk thereto, the nylon yarns in the pile being intermixed with non-reflective metallized yarns in accordance with the invention. Because of the metallized nature of these yarns, the pile will not sustain static charges, and hence the floor covering is static-resistant.

At the same time, the floor covering in accordance with the invention has all of the existing advantages of conventional nylon carpets. The reason nylon, among the true synthetics, is commercially preferable to virtually all other synthetic materials is that this material has superior toughness and abrasion-resistance, as well as possessing low density and high bulk, uniformly high tenacity or strength, high elongation and exceptional elastic recovery, low moisture-absorption with rapid drying and non-flammability.

The nature of nylon allows virtually limitless color possibilities in dyeing. In dyeing, either dispersed or neutral dyeing metallized colors are used, depending upon the fastness properties required. In practice, the piece to be dyed is loaded in a dyebed on a reel, and is dyed therein in open-width fashion.

The invention is by no means limited to tufted floor coverings, and the metallized yarn may be incorporated in the pile in any existing form of woven rug, such as an Axminster rug wherein the metallized nylon yarns in accordance with the invention are included in the pile, the rug further including the usual chain, filling and stuffer yarns. The metallized nylon yarn may also be included in textile fabrics intended for clothing, furniture coverings or for any other purpose.

To produce one preferred form of a non-reflecting metallized yarn in accordance with the invention, use is made of a strong non-woven paper made of nylon fibers, the paper being permeable and having relatively high wet strength. A continuous web **13** of nylon paper drawn from a supply roll **14** is metallized on both faces thereof with tin or other non-oxidizing metal. This may be accomplished in a vacuum chamber **15**.

In the vacuum chamber, one face of the web is metal-plated by tin, magnesium, titanium, or whatever metal is used, the thickness of the metal formed on the paper approaching the molecular. The deposition may be carried out by known thermal evaporation or cathodic sputtering techniques.

In thermal evaporation, metal vapor is generated by direct heat such as an electric arc source or a glowing filament. To effect maximum adherence of the plated film, the metal atoms should pass linearly from their course to the surface to be coated, and this requires the maintenance of pressures of about 10^{-4} of mercury in the vacuum chamber. In cathode sputtering, a high voltage is impressed between an anode and a cathode of the plating metal. The cathode is vaporized by positive-ion bombardment, some of the vapor diffusing away from the cathode and depositing on the web to be plated. The voltage requirements depend on the nature of the cathode metal. At pressures of 0.01 to 0.10 mm. of mercury necessary to maintain the glow discharge, the ordinary laws of diffusion prevail. After plating, the web is re-rolled in preparation for the next step.

The metallized non-woven paper web **16**, as shown in magnified form in FIG. 3, is constituted by a random network of nylon staple fibers which are interlocked with each other as in conventional paper formations using cellulosic fibers.

In vacuum plating an impermeable film material such as Mylar, an extremely thin layer is formed on the smooth surface of the film which gives rise to a mirror-like finish that is highly reflective and produces glitter. But in the present invention, the paper is permeable, and in vacuum plating the metal vapor penetrates and impregnates the paper to metallize the interior as well as the exterior surfaces of the fibers. As a consequence, instead of a uniform, two-dimensional metallic layer, the metal is dispersed to form a three-dimensional lattice of high electrical conductivity. The resultant metallic finish is non-reflective or matte in character, and the metallized nylon paper is no more difficult to dye than pure nylon or other non-metallic synthetic or natural fibers.

The metallized paper web **16** is then conveyed through a multiple-disc slitter **17**, or any other known type of slitter mechanism to produce a multiplicity of metallized ribbons **18**, all of the same width, which in practice may be a quarter of an inch or less. These ribbons are then given yarn-like properties by conventional twisting and texturizing techniques.

The ribbons may be supported on a filamentary core of nylon or other suitable thread material, as shown in FIG. 4, wherein the ribbon **18** is wound about a thread or filamentary core **19**.

The metallized paper yarn produced in the manner described above, may then, in conjunction with standard yarns, be converted by knitting, weaving, tufting or any other known technique, into clothing fabrics or fabric coverings, rugs, carpets, drapes, or any other product in which static charges represent a problem. The ratio of the metallized paper yarns to the standard yarns is not critical, and one may empirically determine the relative amount of metallized yarn necessary in a given product to render it shock-free.

Thus a metallized paper yarn in accordance with the invention, has the same electrical effect as a metal wire in providing a discharge path for electrostatic charges, without, however, visibly introducing glitter or other metallic effects in the product.

While there has been shown and described a preferred embodiment of static-charge resistant synthetic yarn in accordance with the invention, it is to be understood that many changes and modifications may be made therein without departing from the essential spirit of the invention. For example, though tin is given as a preferred form of non-oxidizing metal, aluminum in the context of the present invention may also be regarded as non-oxidizing, for though a thin oxide film will

quickly form on the aluminum surface after it is vacuum-plated on the paper, this film acts to inhibit further oxidation so that the aluminum remains electrically conductive to discharge electrostatic charges.

The invention is not limited to yarns formed of nylon paper, for similar results may be obtained using treated nylon film. Nylon film ordinarily has a smooth surface so that when vacuum-plated, the metal layer is highly reflective and produces glitter. However, in accordance with the present invention, the surfaces of the nylon film web, before being tin plated, are roughened or abraded, as by well-known sand-blasting techniques or abrading machines of the type presently used to remove the shine from polypropylene film material. Thus the surfaces of the nylon film then have formed thereon a myriad of minute peaks and valleys. When these surfaces are thereafter tin-plated, instead of a uniform, two-dimensional metallic layer, the metal is dispersed in the peaks and valleys to define a three-dimensional lattice, just as in the case of nylon paper.

The resultant metallic finish on the treated web is dull, non-reflective or matte in character, and the metallized nylon web is no more difficult to dye than pure nylon or other non-metallic synthetic or natural fibers. The term matte is used in the sense of evenly roughened to provide a lusterless surface.

Similar results may be obtained with polyester films, including Mylar, and polyolefin films, which are treated so that the surfaces are roughened before being plated. In practice, instead of roughening smooth films, the film webs may be extruded through dies which impart roughened surfaces thereto. The advantage of using films of nylon or other material rather than non-woven nylon paper is that these films are somewhat easier to slit to convert the web into ribbons for producing yarn.

I claim:

1. A metallized yarn constituted by a flat ribbon formed of nylon film whose faces are rough lusterless surfaces, the faces of said ribbon being coated with an extremely thin layer of a metal selected from the class consisting of tin and aluminum which covers the rough surfaces to create a non-reflective three-dimensional lattice of high electrical conductivity forming an electrically-conductive path to discharge electrostatic charges.

2. A yarn as set forth in claim **1**, wherein said ribbon is formed of nylon film whose faces are abraded to impart roughness thereto.

3. A yarn as set forth in claim **1**, wherein said ribbon is wound about a filamentary core.

4. A yarn as set forth in claim **1**, wherein said ribbon is twisted.

5. A yarn as set forth in claim **4**, wherein said twisted ribbon is texturized.

6. A carpet having a pile constituted by non-metallized nylon fibers intermixed with metallized yarns of the type set forth in claim **1**, to render said carpet electrically shock-free.

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