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SELF-EXTINGUISHING AND STATIC CHARGE RESISTANT PILE FABRIC

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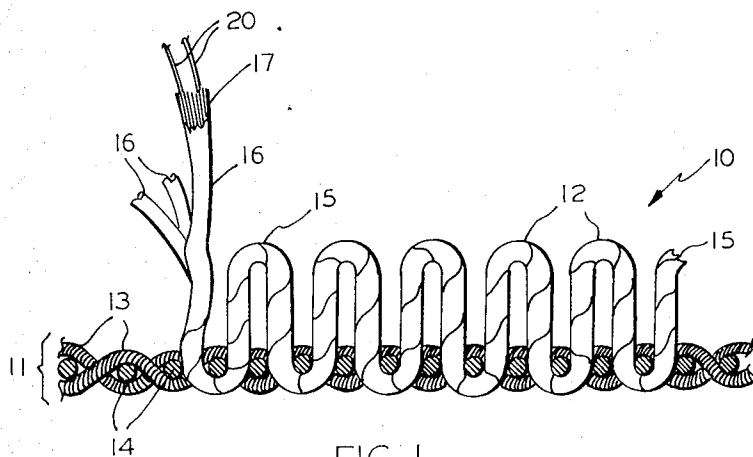


FIG. 1

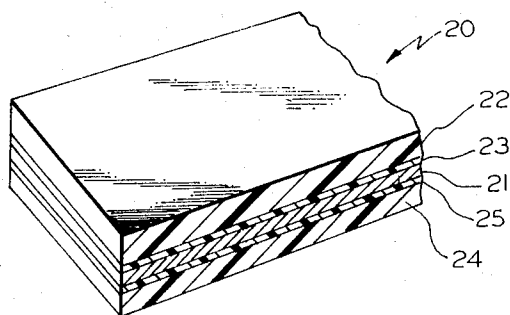


FIG. 2

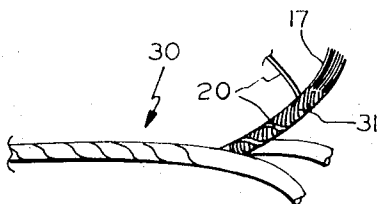


FIG. 3

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SELF-EXTINGUISHING AND STATIC CHARGE RESISTANT PILE FABRIC

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7 Claims

ABSTRACT OF THE DISCLOSURE

A pile fabric comprising:

(A) a backing material and,

(B) pile loops anchored in said backing material, said pile loops comprising:

(1) a flammable fiber and,

(2) a metallic laminate thread comprising:

(a) a self-supporting metal ply and,

(b) a polymeric ply bonded to the metal ply.

These pile fabrics are self-extinguishing and static charge resistant.

This invention relates to pile fabrics containing a metallic laminate thread. The pile fabrics of the present invention are flame retardant and static charge resistant.

Pile fabrics of flammable natural fibers such as cotton are of ancient origin and have been used for many years as rugs and carpets. More recently, synthetic polymeric fibers, which are also flammable such as cellulosic fibers, acrylic fibers, polyester fibers, nylon fibers, and polypropylene fibers have found increasing use as materials of construction for pile fabrics.

Attempts to render pile fabrics less flammable or self-extinguishing have met with only limited success. Although treatment with known flame retardant materials reduces flammability, the treated fabric frequently possesses certain undesirable characteristics such as inferior hand or reduced softness. Furthermore, such treatment involves additional processing steps adding to the expense of preparing the fabric. In addition, these flame retardant materials are frequently removed from the pile fabric in the course of time by successive washing or shampooing.

In the case of polymeric materials, bromine containing monomers have been introduced into the polymer structure during the production of the polymer in order that textile filaments produced from these polymers will be self-extinguishing. While this method has met with varying degrees of success, the filaments of these polymers are generally more expensive than their bromine free counterparts. Still another means for rendering pile fabrics flame retardant is by coating the backing materials of the pile fabric with a flame retardant material as described, for example, in Perri, U.S. Pat. 3,040,707; or by the use of cellulose acetate described in Wallach U.S. Pat. 1,995,696.

Another problem encountered in pile fabrics is the build up of static electricity when a person walks across a carpet of such a fabric. Under certain circumstances, and especially under conditions of low humidity, the static electrical charge on the person can build up to such an extent that contact with a grounded body causes an uncomfortable shock. This undesirable property of pile fabrics of polymeric materials has retarded their wider use as carpets. Many attempts have been made to provide pile fabrics with means for discharging the static charge such as, for example, incorporating an electrically conductive cord into the pile of the fabric as described, for example, in Cadwell et al., U.S. Pat. 2,302,003; or by the

incorporation therein of metal studs as described, for example, in Bloch, U.S. Pat. 3,001,264. However these methods have not met with wide commercial success for a variety of reasons. For instance, when the cord is rendered conductive by the use of carbon, this carbon is released during wear creating a dirt problem and reducing the conductivity of the cord. The use of metal studs creates an undesirable appearance in the pile fabric and a sensation on bare feet akin to that of a stony beach. Additionally conductive cords, metal studs, and conductive metallic wires are not receptive to the dyes normally used to color pile fabrics. Since they resist coloration, their presence is always apparent in a pile fabric.

It is, therefore, an object of the present invention to provide a novel pile fabric which is flame resistant and self-extinguishing.

Another object of the present invention is to provide a novel pile fabric which is resistant to the build up of a static electrical charge.

A further object of the present invention is to provide a novel pile fabric which is self-extinguishing and free of fire retardant chemicals.

A still further object of the present invention is to provide a novel pile fabric which is self-extinguishing and which can be manufactured by conventional pile fabric manufacturing machines without the necessity of further processing steps.

Yet, another object of the present invention is to provide a novel pile fabric which retains its self-extinguishing character in spite of successive washings.

Still another object of the present invention is to provide a novel method for rendering pile fabrics self-extinguishing and for rendering them resistant to the build up of static electrical charges.

Still another object of the present invention is to provide a novel pile fabric employing a dyeable electrically conductive thread.

Still another object of the present invention is to provide a novel pile fabric containing a metallic laminate thread.

Additional objects and advantages will be apparent by reference to the following detailed description of the invention, a preferred embodiment thereof, and the figures of the drawings wherein:

FIG. 1 is a warp wise section of a pile fabric of the present invention; and

FIG. 2 is a greatly enlarged isometric view of a metallic laminate thread which can be employed in the pile fabrics of the present invention; and

FIG. 3 represents one embodiment of a yarn containing a metallic laminate thread which can be used in the pile fabrics of the present invention.

By the present invention, there is provided a pile fabric comprising:

(A) a backing material and,

(B) pile loops anchored in said backing material, said pile loops comprising:

(1) a flammable fiber and,

(2) a metallic laminate thread comprising:

(a) a self-supporting metal ply and,

(b) a polymeric ply bonded to the metal ply.

The pile fabrics of the present invention are self-extinguishing and have a high resistance to the build up of static electrical charges. The use of metal is well-known in the pile fabric art as shown, for example, by U.S. Pats. 2,385,577; 2,508,852; and 2,764,185; and in the non-pile fabric art as described, for example, in U.S. Pats. 1,004,622; 1,898,025; 2,385,577; and 3,126,924. However in these patents metal has been used in the form of wire for purposes other than the imparting of flame-

retardancy. The prior art has failed to recognize or suggest either the structure or the advantages of the pile fabrics of the present invention which contain the metallic laminate threads as described herein.

Referring now to the drawing, and in particular to FIG. 1 thereof, there is shown a pile fabric 10 which comprises a backing material 11 having pile loops 12 anchored to the backing material 11. In the embodiment shown, the backing material 11 comprises chain yarns 13 interwoven with filler yarns 14 as is well-known in the art. The backing material 11 can have any other structure heretofore employed as backing materials for pile fabrics. The backing material 11 can be constructed of any of the films heretofore used in the art such as jute, hemp, cotton duck, or polyback. The pile loops 12 are constructed of a yarn 15, which consists of two or more strands 16. Three and four strand yarns 15 are commonly employed and are preferred. The yarn 15 contains a metallic laminate thread 20 which is preferably present in an amount equal to 2 to 90 and preferably 4 to 15 percent by weight of the yarn 15. The balance of the yarn 15 comprises flammable fibers 17.

Referring now to FIG. 2, there is shown a preferred metallic laminate thread 20 which can be used in the pile fabric 10. These metallic laminate threads 20 are known in the art and can be produced by known procedures such as described, for example, in Scharf, U.S. Pat. 3,069,746. In general, the metallic laminate thread 20 comprises a metal ply bonded on one side thereof to a polymeric ply 22 by any suitable means such as an adhesive 23. In the preferred embodiment of the metallic laminate thread 20, depicted in FIG. 2, the other surface of the metal ply 21 is also bonded to another polymeric ply 24 by means of an adhesive 25. The metal ply 21 can be of copper, silver, nickel, chromium, lead, tin, aluminum and alloys thereof. Aluminum is preferred because of its combination of properties such as high ductility, lustre, electrical conductivity, thermal conductivity and resistance to darkening by oxidation. The polymeric ply 22 can be the same or different as the polymeric ply 24. Although any of the well-known polymeric materials can be used, the preferred polymers are the fiber forming polymers having a high tensile strength such as, e.g., the cellulosic materials such as cellulose butyrate; the polyamides, such as nylon, the polyolefins, such as crystalline polypropylene, and most preferably, the polyesters, such as polyethylene terephthalate commercially available as Mylar which is the most preferred material. The metallic laminate thread 20 can be produced by procedures well-known in the art by combining a polymeric ply 22 with a self-supporting metal ply 21.

The metallic laminate threads 20 useful in the present invention can have a width of from less than 0.001 inch to over 0.250 inch although widths within this range are preferred and a width of 0.0156 inch has been found suitable for most applications. Depending upon factors such as the width of the thread 20 and the thickness of the plies 21 and 22, whether there is a second polymeric ply 24, its thickness, the amount of adhesive 23 and 25, the metallic laminate threads 20 useful in the present invention can have a denier of 125 to 500 and preferably from 200 to 500.

The metallic laminate thread 20 can be incorporated into the yarn 15 by a variety of processes but is most conveniently and preferably incorporated therein during the spinning or twisting operations. For instance, as shown in FIG. 3 when the metallic laminate thread 20 is spun away from the path of the fibers in the spinning operation, the result is a yarn 30 having the metallic laminate thread 20 on the surface of the strand 31. In this case, the strand 31 consists of flammable fibers 17. Strands consisting essentially of filaments of the metallic laminate thread can be combined with other strands consisting essentially of the flammable fiber. The most preferable method of incorporating the metallic filament 20 into the yarn em-

ployed in the construction of the pile fabrics of the present invention is to add them during the spinning operation in which case the resultant yarn has the structure shown in FIG. 1 as the yarn 15. Other methods of incorporating the metallic laminate thread 20 into yarns will be readily apparent to those skilled in the art and any method by which they are uniformly distributed throughout the yarn is effective to impart the self-extinguishing character to the pile fabric as long as the metallic laminate thread is present in the specified weight ratio. When the metallic laminate thread 20 is thinner or when the metal ply 21 is thinner or both, a slightly increased weight ratio of the metallic laminate thread 20 is required in order to impart the same degree of flame retardancy. When employing metallic laminate threads of varying thicknesses having metal plies 21 of varying thicknesses, the minimum amount necessary to impart flame retardancy can be readily and easily determined by those skilled in the art. For instance when the metal ply 21 has a thickness of 0.00045 inch (45 gauge) flame retardancy will be imparted when the yarn contains five weight percent of a thread of this laminate. It will be apparent that the pile fabrics of the present invention can also contain some yarns which are free of the metallic laminate threads 20 as long as yarns employing these threads are distributed evenly throughout the fabric.

The preferred flammable fibers 17 are those of polymerized acrylonitrile, which can contain up to 20 percent of a vinyl monomer copolymerizable therewith. Examples of suitable vinyl monomers include among others, allyl alcohol, vinyl acetate, acrylamide, methacrylamide, methyl acrylate, 2-vinyl pyridine, ethylene sulfonic acid and its alkali metal salts, vinyl benzene sulfonic acid and its salts, 2-sulfoethylmethacrylate and its salts, vinyl lactams such as vinyl caprolactam and vinyl pyrrolidone, ad mixtures thereof. Thus the term acrylonitrile polymer includes homopolymers of acrylonitrile and random, block, and graft interpolymers containing at least 80% by weight acrylonitrile. These fibers of acrylonitrile polymers are well-known in the art and are commercially available and need not be further described.

The invention may be better understood by reference to the following examples in which all parts and percentages are by weight unless otherwise indicated. The operative examples are illustrative of certain embodiments designed to teach those skilled in the art how to practice the invention and to represent the best mode contemplated for carrying out the invention, and are not intended to limit the scope of the invention in any manner.

EXAMPLE 1

This example illustrates the construction and structure of a metallic laminate thread useful in the present invention.

A sheet of aluminum 0.00045 inch thick (45 gauge) is laminated to two sheets of polyethylene terephthalate 0.0005 inch thick (50 gauge) employing polyester adhesive. The metallic laminate thus produced is heated for 60 minutes and 170° C. to cure the adhesive and bond the polymeric plies to the aluminum ply. The laminate is then slit into threads $\frac{1}{4}$ inch wide to form a metallic laminate thread of 240 denier.

EXAMPLE 2

This example illustrates the production of yarns formed of strands containing a metallic laminate thread. These yarns are useful in the pile fabrics of the present invention.

A single strand of the metallic laminate thread of Example 1 is added to a fiber of homopolymerized acrylonitrile in the spinning operation making a 2/1 cotton count strand. Two of these strands are twisted together to make a 2-ply yarn containing 9.0 weight percent of the metallic laminate thread, based on the weight of the yarn. This yarn is termed Yarn A.

5 EXAMPLE 3

This example illustrates the production of another yarn containing metallic laminate threads useful in the present invention.

The procedure of Example 2 is repeated with the single exception that the metallic laminate thread is spun away from the path of the fiber in the spinning operation. The resultant yarn has a structure similar to that shown in FIG. 3. This yarn is termed Yarn B.

EXAMPLE 4

This example illustrates the production of still another yarn containing metallic laminate threads useful in the present invention.

A 4-ply yarn is constructed by twisting together two strands consisting of filaments of the metallic laminate thread of Example 1 and two strands consisting of filaments of homopolymerized acrylonitrile. This yarn is termed Yarn C.

EXAMPLE 5

This example illustrates the production of yet another yarn containing metallic laminate threads useful in the present invention.

The procedure of Example 4 is employed except that one strand of metallic laminate thread is employed instead of two. This yarn is termed Yarn D.

EXAMPLE 6

This example which is not illustrative of the present invention, is set forth for comparison.

A control yarn of 100 percent polymerized acrylonitrile and containing no metallic laminate thread is twisted together to make 2/2 cotton count yarn. This yarn is termed Yarn E.

EXAMPLE 7

This example which is not illustrative of the present invention, is also set forth for comparison.

A control sample of three strands of filaments, 70 percent of which are homopolymerized acrylonitrile and 30 percent of which are modified acrylic fibers are twisted together to make a 2/2 cotton count yarn. The modified acrylic fibers used herein are sold by the Eastman Kodak Co. under the trade name, Verel, and are reported produced from copolymers of 60% acrylonitrile and 40% vinylidene chloride. This yarn is termed Yarn F.

EXAMPLE 8

This example illustrates the self-extinguishing character of the pile fabrics of the present invention.

The yarns listed in Table 1 are tufted into a jute backing material to form pile fabrics. These fabrics are tested for their self-extinguishing character at room temperature (20° C.) under ambient and bone-dry conditions. The backing material contains no latex. The flammability test is conducted by igniting a timed burning pill of methenamine made by the Eli Lilly Co. The results of these tests are listed in Table I.

TABLE I

Designation of yarn in the pile fabric	Weight percent of metallic laminate thread in yarn	Test results at ambient conditions ¹	Test results at bone-dry conditions ²
A-----	9.0	Self-extinguishing	Slow burning and not self-extinguishing
B-----	9.0	do	Do.
C-----	9.0	do	Do.
D-----	4.5	Burn completely and self-extinguishing	Burn completely
E-----	0	Burn completely	Do.
F-----	0	Slow burning and not self-extinguishing	Do.

¹ Tested at 20° C., 65% relative humidity, atmospheric pressure.

² That condition existing after the pile fabric has been subjected to a ventilated oven at 60° C. for 25 minutes and then immediately tested.

6 EXAMPLE 9

This example illustrates the antistatic properties of the pile fabrics of the present invention.

The pile fabrics of Example 8 employing Yarns A, D, and F are subjected to a static electricity test. This test is conducted by rotating a circular sample of the pile fabric 4¼ inches in diameter at a speed of 1,800 r.p.m. while allowing a brass roller to rub against the pile of the sample. A static probe is connected to the brass roller to detect any static charge which develops. The static charge is measured in electrostatic units (e.s.u.) by an electrostatic volt meter and the results of these tests listed in Table II.

TABLE II

Designation of yarn in the pile fabric	Weight percent of metallic laminate thread in yarn	Static electricity (e.s.u.)		
		Finish containing yarn ¹	After detergent wash ²	After solvent treatment
A-----	9.0	0	0	0
D-----	4.5	0	0	0
F-----	0	0	0	3,100

¹ As received from the manufacturer.

² These samples are washed with a detergent commercially available as "Karpot Kare", rinsed with water, dried, and equilibrated in air for 24 hours at 20° C., 65 percent relative humidity.

³ These samples are successfully washed with agitation in each of three separate baths of isopropanol.

Although the invention has been described in considerable detail with reference to certain preferred embodiments thereof, it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described above and as defined in the appended claims.

What I claim is:

1. A pile fabric comprising:

(A) a metal-free backing material and,

(B) pile loops anchored in said backing material, said pile loops comprising:

(1) a flammable fiber, and

(2) a metallic laminate thread comprising:

(a) a self-supporting metal ply and,

(b) two polymeric plys bonded to opposite sides of said metal ply.

2. The pile fabric of claim 1, wherein the metal ply is aluminum.

3. The pile fabric of claim 1, wherein the polymeric plys are polyethylene terephthalate.

4. The pile fabric of claim 1, wherein the metallic laminate thread comprises from two to ninety weight percent of the yarn of the pile loops.

5. The pile fabric of claim 1, wherein the flammable fiber is a polymer of acrylonitrile.

6. The pile fabric of claim 1, wherein the flammable fiber is nylon.

7. The pile fabric of claim 1, wherein the flammable fiber is a polyester.

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WILLIAM A. POWELL, Primary Examiner

U.S. Cl. X.R.

57—140; 139—391; 161—175, 403