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[54] **NOVEL HIGH TEMPERATURE RESISTANT FABRICS**

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[58] **Field of Search** ..... 161/88, 89, 90, 91, 92, 161/93, 175, 227, 146; 28/74 R, 75 R; 117/128, 128.4, 138.8 N, 161 P; 139/383 R, 419, 420 R; 74/231 R, 232, 239

[56] **References Cited**

UNITED STATES PATENTS

2,679,677	6/1954	Crandall	161/90
3,595,730	7/1971	Richardson	161/89

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[57] **ABSTRACT**

A novel open weave fabric is disclosed which comprises in a leno weave, warp yarns of polyamide fiber and crossover yarns of polyamide fiber braided over a core of glass fibers and/or metal wire. The fabric weave is then finished with a coating of a high temperature resistant resin selected from polyamides, polyimides, polyamide-imide or derivatives thereof. The fabric of the invention is useful for fabricating conveyor belts employed in conveying textiles through dryers and in like applications.

11 Claims, No Drawings

NOVEL HIGH TEMPERATURE RESISTANT FABRICS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention concerns high temperature resistant synthetic fabrics and more particularly concerns a high temperature resistant, coated open weave fabric and dryer belts made therefrom.

2. Description of the Prior Art

The requirements for dryer belts have become more and more demanding as the textile industry continues to evolve. The demand for higher temperature drying ovens, faster machine throughputs, and more complete solvent recoveries to meet pollution requirements in the textile industry have created a demand for dryer belts which will tolerate the more severe conditions without a significant reduction in operating life.

Prior hereto, metal mesh belts have been employed as dryer belts in textile dryers. However, the metal belts exhibit poor flex fatigue resistance and track poorly, particularly when run at high speeds. Also, over a relatively short period of time, small wire strands break and bend leaving a sharp point which will catch and damage the textile being conveyed.

Synthetic belts employed previously have included, for example, fiberglass fabrics coated with polytetrafluoroethylene. These synthetic fabrics generally enjoy short lives as dryer belts, having a relavitely poor resistance to abrasion, relatively low strength and poor tracking ability at high speeds.

Open weave nylon Fourdrinier wires have been employed extensively in papermaking, particularly nylon fabrics coated with phenolic-aldehyde resins (see for example, U.S. Pat. No. 3,032,441). Although such fabrics are excellent in terms of their durability and long life they generally have low air permeability and therefore are of limited value where a high volume of air passage is desired (as is the case of dryer belts for the drying of textiles).

We have found that a particular open weave, employing particular warp and weft yarns and coated with particular types of resin compositions yield fabrics particularly valuable for dryer belts. The dryer belts fabricated from the fabric of the invention show high temperature resistance, dimensional stability in spite of a very open weave, high air permeability, excellent tracking characteristics at high speeds and a high degree of abrasion resistance. Surprisingly, these advantageous properties are obtained in a fabric product which is substantially lighter and more flexible than fabrics previously employed to fabricate dryer belts. One would not ordinarily expect to obtain longer life and better durability in the lighter dryer belts of the invention. Furthermore, the light weight and better flexibility of dryer belts fabricated from fabrics of the invention provide for easy installation on existing textile dryers. The heavier prior art dryer belts are generally more difficult to install.

SUMMARY OF THE INVENTION

The invention comprises a high temperature resistant, open weave fabric which comprises; in a leno weave, (i) warp yarns comprising a high temperature resistant polyamide fiber and (ii) crossover yarns which comprise a high temperature resistant polyamide fiber braided over a core selected from glass fiber, metal wire and mixtures thereof; said weave being coated with a high temperature resistant resin selected from polyamides, polyimides, polyamide-imides and mixtures thereof. The fabrics of the invention are especially useful as dryer belts and the invention also comprises dryer belts fabricated from the fabrics of the invention.

The term "high temperature resistant" as used herein means an ability to withstand temperatures of from about 100° F. to at least about 350° F. Certain embodiments of the invention will withstand temperatures of at least about 500° F. without substantial degradation and are preferred for applications where the higher temperature resistance is required.

DETAILED DESCRIPTION OF THE INVENTION

The fabrics of the invention are prepared according to the process of the invention by weaving the warp and crossover yarns in a leno weave and then coating the woven fabric with a high temperature resistant resin composition as specified in greater detail hereinafter. The woven fabric will have an average yarn count of 6 by 5 per square inch.

The warp yarns may be any multifilament polyamide yarn prepared for example from fibers of nylons such as nylon 6; nylon 6,6; nylon 6,10; nylon 11 and the like. Particularly preferred for the higher temperature applications are yarns prepared from aromatic polyamides and most preferred are yarns prepared from fibers of the polyamide polymer of m-phenylenediamine and isophthaloyl chloride. Such fibers are well known as is their preparation and the preparation of multifilament yarns therefrom.

In general, the warp fibers have a denier in the range of from about 840 to about 1,680 and preferably within the range of from about 840 to about 1,260. The warp yarns advantageously have a breaking strength of between about 40 to about 20 lbs. (min.) and preferably between about 30 to about 25 lbs. (min.). An elongation of between about 10 percent to 7 percent at 3 gms. per denier is most advantageous for polyamide fibers employed in the warp yarns.

The crossover yarns are prepared by braiding a polyamide fiber multifilament yarn, such as one within the scope of those described above for the warp yarns, over a core material. Preferred as the polyamide fiber in the crossover yarn is the fiber obtained from the polyamide polymer of m-phenylenediamine and isophthalyol chloride and most preferred is such polyamide fiber having the breaking strengths, elongation and denier set forth above as advantageous for the warp yarns.

The core materials used in the crossover yarns may be glass fibers, individually or in a bundle, such as B glass, E glass and like fibers; metal wire such as chromel R, Rene 41, Halstelloy B, phosphorous bronze and the like; and combinations of the above. Preferred as the core material is a bundle of fiberglass (multiple glass fibers) with a single strand of phosphorous bronze wire. The fabrication of such composite yarns is well known in the art and need not be discussed here.

The woven fabric is coated by any conventional means of coating fabrics with a resin such as by dipping, spraying or doping with a high temperature resistant resin composition hereinafter described. The coating is applied so as to completely and evenly encapsulate the warp and weft yarns and their component filaments. This generally also serves to provide additional

stability to the fabric by bonding the warp and weft yarns together at the crossover points.

The amount of resin applied is generally not critical, however, the fabrics of the invention advantageously are coated with resin in a proportion such that the fabric weight is increased by from about 5 percent to about 100 percent. Thus, the fabric of the invention has a weight of which from 2.5 to 50.0 percent comprises resin weight. Preferably the proportion of resin is such that the weight of the woven fabric is increased by from about 5 percent to about 30 percent. Thus, the preferred fabrics of the invention have a weight of which from 2.5 percent to 15 percent comprises resin weight.

The resin coating employed may be any high temperature resistant resin coating composition selected from solutions, mixtures or dispersions of a polyamide, polyimide, polyamide-imide resin and mixtures thereof.

More specific examples of the resin coatings employed to make the coated fabrics of the invention are, for example, the coating compositions of polyamide acids which upon curing yield a polyimide coating or a polyamide-imide coating (see for example U.S. Pat. Nos. 3,179,633; 3,179,634; 3,518,219; 3,541,036; 3,546,152; 3,652,500 and 3,702,788 disclosing such polyimide and polyamide-imide forming coating compositions).

Polyamide coating compositions such as nylon coatings are generally well known, such as for example the copolymers of nylon 6, nylon 6,10 and nylon 6,6 dissolved in organic solvents such as aliphatic alcohols and mixtures of aliphatic alcohols with water.

Preferred resin coatings for preparing the fabrics of the invention are the polyamide-imide polymers, more particularly described as polytrimellitamides, being prepared by the reaction of aromatic diamines with aryl halide derivatives of trimellitic anyhdrides. The methods of their preparation are well known; see for example the methods of U.S. Pat. Nos. 3,049,518 and 3,260,691. Coating compositions of the preferred polytrimellitamide are generally well known and are commercially available (see for example the compositions of polytrimellitamide polymer enamel described in U.S. Pat. No. 3,451,848).

In addition to the high temperature resistant resin applied as a coating to the woven fabric, other conventionally employed coating materials may be applied concurrently with the high temperature resin or in a separate treatment. For example, silicone compounds may be advantageously applied separately or concurrently with application of the high temperature resistant resin coating to enhance release characteristics of the fabrics of the invention. Such silicone compounds for enhancing release characteristics of synthetic fabrics are well known and are commonly employed in textile finishes.

The following examples describe the manner and process of making and using the invention and set forth the best mode contemplated by the inventors of carrying out the invention, but are not to be construed as limiting.

EXAMPLE 1

A. Weaving of Fabric

A 2 ply, 1,200 denier continuous filament (weighing circa 0.101 gms. per 30 inches) obtained from a polymer of m-phenylenediamine and isophthaloyl chloride (Nomex, E. I. DuPont de Nemours and Co., Wilmington, Delaware) and comprised of 9.95 twist singles and 9.95 twist ply, the finished yarn having a tenacity of 5 gms. per denier and an elongation of 8 percent at 3 gms. per denier and a weight of 397 grams per 100 yards, is woven as the warp with a filling yarn of 4 end braid of 1,200 denier continuous filament obtained from the same yarn described above for the warp, braided over a core consisting of a bundle 75/1 fiberglass with a single strand of 0.008 inch diameter phosphorous bronze wire. The warp yarns are spaced in five groups of two yarns each per inch and woven on inverted doup leno harnesses to produce a half-twist between each crossover yarn insertion. The crossovers are inserted at six yarns per inch. The weight of the woven fabric is about 1.36 ounces per square foot.

B. Coating of the Fabric

A treating solution is made by diluting a 30 percent solution of the polytrimellitamide polymer obtained by reaction of p,p'-diaminodiphenylmethane with trimellitic anhydride acid chloride in N-methylpyrrolidone (AI 1030, Amoco Chemicals Co., Chicago, Illinois) with sufficient N-methylpyrrolidone to obtain a polymer concentration of about 10 percent by weight. The fabric of Part A, supra., is impregnated with the treating solution so as to increase the fabric weight by 10 percent, after drying and curing the resin impregnated fabric. After treatment with the resin solution, the wet fabric is dried for about 15 minutes at a temperature of 400° F. and then cured for about 15 minutes at a temperature of about 450° to 500° F.

The coated fabric obtained above is found to have a breaking strength of 245 lbs. per linear inch as determined by the method of ASTM D-1682-64, an elongation of 0.4 percent at 10 lbs. per linear inch loading as determined by ASTM D-1682-64 and an abrasion resistance of 1.95 percent loss of weight after 500 cycles as per ASTM-D-1175-64T (rotary drum method). The fabric has a projected open area of 66.6 percent.

EXAMPLE 2

Following the procedure of Example 1, supra, a fabric of the invention is prepared having a length of 133.3 feet, a width of 94.5 inches, a weight of 87.9 lbs.; a breaking strength of 245 lbs. per inch (ASTM D-1682-64) and a projected open area of 66.6 percent. The fabric is joined at the ends by a fold-back pin seam to make an endless conveyor belt. The belt is easily installed in a tenter oven to support knit fabrics during heat setting. The belt operates at speeds of circa 90 yards per minute and at temperatures of between 350°–400° F. The belt tracks well, shows excellent dimensional stability and is highly resistant to abrasion. In particular, the belt shows excellent abrasion resistance on the edges, in contrast to open weave fiberglass belts coated with polytetrafluoroethylene which abrade on the edges while operated under the same conditions. The belt of this example also shows better dimensional stability, strength and track in comparison to the fiberglass belts coated with polytetrafluoroethylene. In comparison to a stainless steel wire belt, the belt of this Example 2 shows a better flex fatigue resistance and improved tracking characteristics.

What is claimed is:

1. A high temperature resistant open weave fabric which comprises:

in a leno weave,

i. warp yarns comprising a high temperature resistant polyamide fiber and

ii. crossover yarns which comprise a high temperature resistant polyamide fiber braided over a core selected from glass fiber, metal wire and mixtures thereof;

said wrap yarns and said crossover yarns of said weave being coated with a high temperature resistant resin selected from polyamides, polyimides, polyamideimides and mixtures thereof.

2. A fabric according to claim **1** wherein said warp yarns are polyamide fibers obtained from polyamide polymers of m-phenylenediamine and isophthalyol chloride.

3. A fabric according to claim **1** wherein the polyamide fiber of said crossover yarns is obtained from the polymer of m-phenylenediamine and isophthalyol chloride and the core of said crossover yarns comprise multiple glass fibers and a single strand of metal wire.

4. A fabric according to claim **3** wherein said metal wire is a phosphorous bronze wire.

5. A fabric according to claim **1** wherein said resin is a polyamide-imide.

6. A fabric according to claim **5** wherein said resin is a polytrimellitamide.

7. A fabric according to claim **5** wherein said resin is the reaction product of p,p'-diaminodiphenylmethane and trimellitic anhydride acid chloride.

8. A fabric according to claim **1** wherein said coating comprises from 2.5 percent to 50 percent of the weight of said fabric.

9. A fabric according to claim **1** wherein said coating comprises from 2.5 percent to 15 percent of the weight of said fabric.

10. A fabric according to claim **1** wherein said polyamide fibers (i) and (ii) have a denier of from about 840 to about 1,680, a breaking strength of between about 40 to about 20 lbs. (min.) and an elongation of between about 10 percent to 7 percent at 3 gms. per denier.

11. An endless dryer belt which comprises a high temperature resistant leno weave fabric having

i. warp yarns comprising a high temperature resistant polyamide fiber;

ii. crossover yarns which comprise a high temperature resistant polyamide fiber braided over a core selected from glass fiber, metal wire and mixtures thereof;

iii. a coating on said warp yarns and said crossover yarns of a high temperature resistant resin selected from polyamides, polyimides, polyamides-imides and mixtures thereof; and

iv. the ends thereof joined together.

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