May 27, 1969 D. W. MAXHAM 3,446,252

BELT FABRIC

Filed Sept. 5, 1967

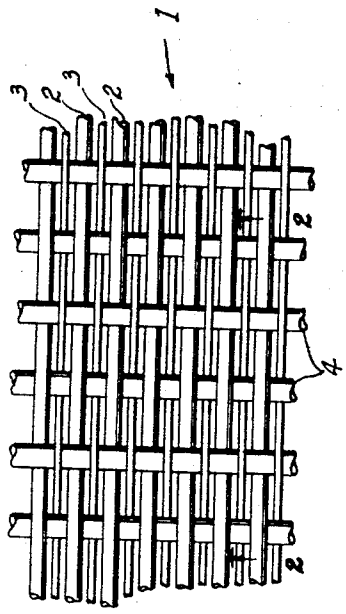

FIG. 1

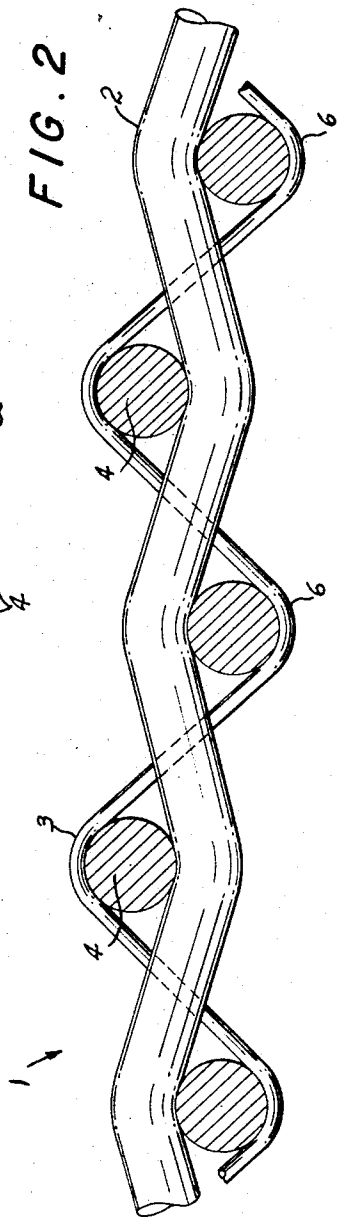

FIG. 2

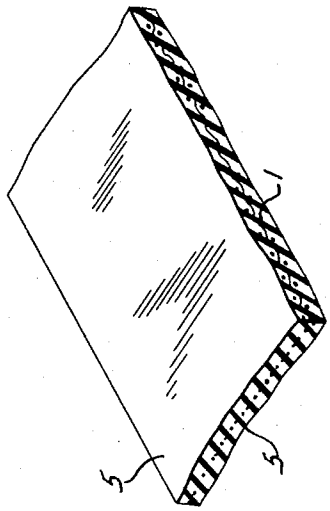

FIG. 3

INVENTOR.
DANIEL W. MAXHAM

BY Henry Sternberg

ATTORNEY

United States Patent Office 3,446,252
Patented May 27, 1969

3,446,252

BELT FABRIC

Daniel W. Maxham, Austell, Ga., assignor to Uniroyal, Inc., New York, N.Y., a corporation of New Jersey

Filed Sept. 5, 1967, Ser. No. 665,466
Int. Cl. D03d 15/00
U.S. Cl. 139—420
10 Claims

ABSTRACT OF THE DISCLOSURE

A fabric having first and second warp yarns of different breaking strength. The percentages of crimp of each being chosen of such magnitude that both said first and said second warp yarns will substantially simultaneously reach their individual breaking loads when an increasing tensile load is applied to the fabric so that the fabric exhibits optimum tensile strength characteristics for the materials employed.

This invention is directed to an improved belting fabric.

More specifically, this invention is directed to an improved fabric for use in reinforced belting such as conveyor belts, elevator belts, transmission belts, and the like.

It is a principal object of this invention to provide a belting fabric having primary strength and binder warps of different characteristics yet arranged in such a manner as to provide optimum fabric tensile strength for the materials employed.

It is another object of this invention to provide a fabric of the above type in which the primary and the binder warps consist of different materials.

It is a further object of the invention to provide a fabric of the above characteristics which has a greater part of its surface composed of material which readily adheres to rubber or the like.

Still another object of the present invention is to provide a fabric having the above characteristics which is relatively simple and economical to produce and, in fact, may be woven on existing looms with a minimum of equipment modification.

A concomitant object of this invention is to provide a belt construction with a single ply fabric carcass thereby avoiding the danger of ply delamination or separation.

The manner in which the invention accomplishes the foregoing objects, as well as additional objects and advantages, will be apparent from the following detailed description, which is intended to be read with reference to the accompanying drawing, wherein:

FIG. 1 is a plan view of a portion of the belting fabric constructed according to this invention;

FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1 in the direction of the arrows and illustrating the fabric components on an exaggerated scale;

FIG. 3 is a perspective partial view of a conveyor belt reinforced with the fabric of the present invention.

Briefly, the belting fabric 1 of this invention is made up of a plurality of interwoven yarns extending generally lengthwise and crosswise, respectively, of the fabric, with the yarns which extend in lengthwise direction comprising a first group of slightly crimped or basic warp yarns 2 and a second group of warp yarns 3 having a substantially higher crimp than said first group of warp yarns. The yarns of the first group 2 may consist of the same or a different material than the yarns of the second group 3, and have a break strength characteristic substantially different from those of the second group. All of the yarns are interwoven in such a manner that substantially all of warp yarns 2 and 3, will substantially simultaneously reach their individual break load in response to application, in lengthwise direction, of increasing tensile load to the fabric. The fabric 1 will, therefore, exhibit optimum tensile strength characteristics for the yarn materials employed.

In its preferred embodiment, the invention takes the form of a belting fabric having a plurality of slightly crimped warp yarns 2 alternating with a plurality of relatively highly crimped warp yarns 3, the latter interlocking a plurality of straight laid wefts 4 extending substantially crosswise with respect to the belting fabric and positioned above and below the warps 2 in nonopposition in the fabric. While, in the preferred structure of the fabric, alternate warps have little and substantial crimp, respectively, i.e., warp yarns 2 have relatively little crimp while warp yarns 3 have a substantially higher crimp, other arrangements are clearly within the scope of the present invention. For example, there may be two warp yarns woven with little crimp for each warp yarn with substantial crimp, or vice-versa. The crimp of the warp yarns 2 should be in the range of 4% to 12%, while the warp yarns 3 have a crimp in the range of from 25%–100%. In the preferred embodiment the crimp of warp yarns 2 is in the range of 5 to 8% while the crimp of warp yarns 3 is less than 100% and preferably between 25 and 75%. The crimp is considered as being the increase of length of a yarn which has been removed from the fabric and straightened (without stretch) over the length of that yarn when in the fabric, expressed as a percentage of the length in the fabric.

The following is an example of a woven fabric according to the invention and suitable for use in a conveyor belt.

MATERIAL

Warp yarn (2)

Type	Type 6 Allied Chemical.
Denier	840/5.
Filament	136 filament.

Warp yarn (3)

Type	18.7 ends per inch.
Staple	7.14/6 Cotton.
Preparation	1 1/32".

Weft (4)

Type	18.7 ends per inch.
Denier	Type 702 Du Pont.
Preparation	840/6 HS Type 702 RFL.
	140 filament
	Picks/inch 13.8.

Construction

Weave: plain weave preferred.

In the preferred embodiment the warp yarns 2 consist of continuous filament nylon yarn and the warp yarns 3 consist of cotton yarn. As shown in FIG. 2, adjacent warp yarns 2, 3 pass on opposite sides of each weft thread 4.

The belting fabric of this invention possesses the unique characteristic of having basic and binder warp yarns so constructed and arranged that while they may be of different materials, different cross-section, etc., nevertheless, both contribute to the extent of their individual maximum tensile strength, when a load nearing the tensile break load of the fabric is applied to the latter. Thus, the construction of the fabric is such that both the binder and basic warp yarns will substantially simultaneously reach their individual break loads so that the breaking strength of the fabric, in lengthwise direction, will be a maximum.

As an example a fabric was woven with 5% basic warp crimp and 45% binder crimp. The basic warp was nylon and the binder was cotton. The nylon yarn had

20% stretch at break and the cotton yarn had 10% stretch at break. In 10" of fabric the 10.5" of nylon yarn stretched to approximately 12.6" at the fabric break load, while, in the same 10" of fabric the binder cotton yarn 14.5" in length stretched to approximately 15.95" at fabric break load. The above yarns broke in the fabric at the same time.

As used herein, the term loading capability of yarn is the ability of a particular yarn or group of yarns to resist a tensile load applied thereto. The term is intended to include such factors as, for example, elastic deformability, i.e. stretchability, of the yarn. A more stretchable warp yarn will not "load" as rapidly as a less stretchable warp yarn of the same diameter, same tensile strength, and same length in the same fabric, when a tensile load is applied to the fabric. The "loading capability" of such yarns will therefore be different. According to the present invention there are provided, at least two groups of warp yarns which, while having a different "loading capability" and thus loading at different rates when a tensile load is applied to the belting fabric, reach their individual breaking loads at substantially the same time or at substantially the same amount of elongation of the belting. The materials and the crimp levels of the basic and the binder warps are chosen in such a manner that both series of warps will break at approximately the same fabric load level, thereby providing an optimum belting fabric, i.e., one having maximum tensile strength for the materials employed. The substantially straight laid, crosswise extending, wefts 4 are preferably positioned alternately on opposite sides of a central plane, with the basic warps 2 extending therebetween substantially in the region of such central plane. Each of the wefts 4 has a first portion located in the region of the central plane and a second portion spaced from such plane. The basic warps 2 engage the wefts at the first portions thereof while the binder warps engage the opposite, or second, portions of the wefts. With the particular plain weave shown in FIGS. 1 and 2, the basic and binder warps cross each other in space substantially at their respective points of intersection with the aforesaid plane, which may also be the neutral plane of the fabric.

Various methods of treatment may be employed to bring about the differential degrees of crimp in the warp yarns. As an example, when the warp yarns are of suitably different materials as outlined above, they may all be subjected to the same degree of tension during weaving with the result that those yarns with the lesser recovery, after release of the tension (for example staple yarn), will have greater crimp than those with greater recovery. Differential recovery of the yarn subjected to the same tension may also be obtained by the use of yarns of different twist.

The preferred method to obtain the desired warp yarn crimps is to meter the required basic warp length and binder warp length during the weaving process. The basic and binder beams are each geared to deliver a specified length for each pick of the loom. The gearing is arranged to give the desired relative crimps in the fabric.

Alternatively the result may be obtained by heat or moisture treatment during or after weaving in order to obtain a differential shrinkage of the yarns. For instance, in the case of fabric having warp yarns composed of fibers of coarse cotton and continuous filament nylon, respectively, the woven fabric may be subjected to steaming to cause the nylon portion thereof to shrink. It is, of course, not essential that a plain weave be used, nor that the two kinds of warp yarns are equal in number.

Evidently, similar results may be achieved by weaves other than the one specifically illustrated. Also, accentuation of the crimp of certain of the warp yarns of the fabric relative to the other yarns thereof can be effected not only by those expedients mentioned heretofore but also by others well-known to the art.

Although it is preferred to use synthetic fibers such as nylon, viscose, rayon, Dacron (polyester), and Fortisan (acetate rayon) for the primary warp yarns, the weft and the binder warps, natural fiber such as cotton may also be employed. Wire strands or glass fibers may also be employed for the fabric components.

The belting fabric according to the present invention is usually not employed as a belt per se but is first impregnated and covered with an elastomeric material usually in the form of layers adhered to one or both sides of the fabric. In the belt shown in FIG. 3, the reinforcement **1** is covered on each side with a layer **5** of polyvinylchloride. The alternate (binder) warp yarns **3** having a substantially greater percentage of crimp than the basic warp yarns **2** accordingly provide, on each side of the fabric **1**, ribs **6** which extend crosswise of the belt and provide large surfaces of fabric material which is readily adherable to rubber or other plastic material comprising the layers **5**. The weft threads **4** also extend crosswise and form the cores of the ribs **6**. Other suitable elastomeric materials for use in forming the layers **5** include natural rubber, synthetic rubbers such as polyurethane rubbers, styrene-butadiene rubbers, butyl rubber, etc. Prior to adhering the elastomeric covering layers **5**, the belting fabric is usually processed for adhesion. Such adhesion processing is well-known in the art and need not be described herein. It should be noted however that with the use of proper materials, for example cotton, for the binder yarns **3**, substantial ribbed surface portions **6** providing excellent strength adhesion properties to rubber are provided while these very same binder yarns **3** add whatever tensile strength characteristics they may possess, to those of the primary yarns **2**, to provide a fabric according to the present invention, which exhibits the maximum tensile strength possible for the materials employed.

While the preferred form of this invention has been described herein, it will be understood that changes in details thereof may be made without departing from the spirit of this invention, and it is intended to cover all those changes which come within the scope of the appended claims.

Having thus described this invention, what is claimed and desired to be protected by Letters Patent is:

1. In a woven fabric, in combination, a plurality of first warp yarns having a given breaking strength and a predetermined first percentage of crimp in the fabric in the range of 4% to 12%; and a plurality of second warp yarns having a breaking strength different from said given breaking strength and having a predetermined second percentage of crimp in the fabric substantially greater than said first percentage but not in excess of 100%, each of said percentages of crimp being chosen within said ranges, respectively, of such magnitude that both of said warp yarns of different breaking strength will substantially simultaneously reach their individual breaking loads in response to the application of increasing tensile load to the fabric whereby the fabric exhibits optimum tensile strength characteristics for the materials employed.

2. A woven fabric according to claim **1**, wherein said first percentage of crimp is in the range of 5–8% and said second percentage of crimp is in the range of 25–75%.

3. A woven fabric according to claim **1**, wherein said first warp yarns having the lesser crimp are made from continuous filament yarn and said second warp yarns having the greater crimp are made from staple yarn.

4. A woven fabric according to claim **3**, wherein the warp yarns having the lesser crimp are made from continuous filament nylon yarn.

5. A woven fabric according to claim **3**, wherein the warp yarns having the greater crimp are made from cotton.

6. A woven fabric according to claim **1**, further comprising a plurality of substantially straight, substantially parallel weft yarns arranged on opposite sides of said first warp yarns.

7. A woven fabric according to claim **1**, wherein indi-

vidual ones of said plurality of first and plurality of second warp yarns extend in planes which are substantially parallel with respect to each other and substantially normal with respect to said weft yarns.

8. A woven fabric according to claim **7**, wherein said first and second warp yarns are interlaced with said weft yarns so as to provide on opposite sides of the fabric a surface contour of alternating ribs and grooves extending transversely with respect to said warp yarns.

9. A woven fabric according to claim **1**, and particularly suitable as a reinforcement for belting further comprising,

a plurality of weft yarns,

said first warp yarns interwoven with said weft yarns and

said second warp yarns also interwoven with said weft yarns.

10. A woven fabric according to claim **9** wherein, alternate ones of said weft yarns are located substantially on one side of a given plane, each of said latter yarns having a first portion adjacent said plane and a second portion spaced from said plane, the remaining ones of said

weft yarns being located substantially on the other side of said plane and each thereof having a first portion adjacent said plane and a second portion spaced from said plane, said first warp yarns engaging said first portions of said weft yarns, while said second warp yarns engage said second portions of said weft yarns.

References Cited

UNITED STATES PATENTS

1,573,559	2/1926	Manley	139—420 X
2,793,151	5/1957	Arnett	161—90 X
3,086,274	4/1963	Arnett	161—91 X
3,148,710	9/1964	Rieger et al.	139—415
3,205,119	9/1965	Paul	139—415 X
3,296,062	1/1967	Truslow	139—426 X

JAMES KEE CHI, *Primary Examiner.*

U.S. Cl. X.R.

139—415; 161—91