United States Patent

[11] 3,537,488

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[45] Patented **Nov. 3, 1970**

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[54] **REINFORCING FABRIC**
8 Claims, 13 Drawing Figs.

[52] **U.S. Cl.** **139/415,** 161/90
[51] **Int. Cl.** **D03d 11/00**
[50] **Field of Search** 139/408–415, 426, 420, 383; 161/90, 91

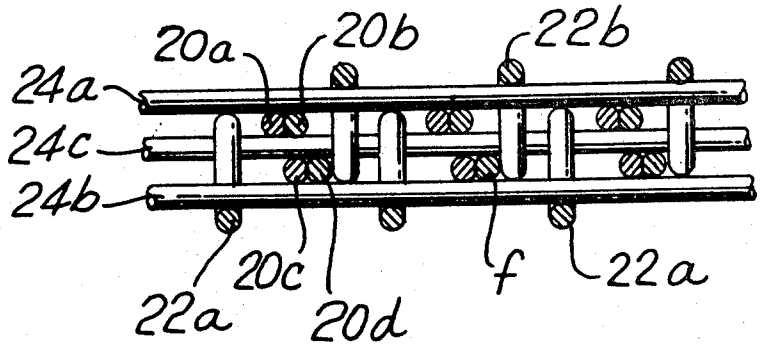
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Primary Examiner—James Kee Chi
Attorney—David B. Miller

ABSTRACT: A fabric particularly adapted for use as a reinforcement for belting, hose walls, and the like, although the fabric also can be used wherever a fabric is subjected to relatively large loads, as in the case of automotive seat belts, for example. The fabric includes basic warp yarns and binder warp yarns as well as weft yarns extending across the warp yarns. The basic warp yarns of the fabric of the invention have a crimp which is less than 2 percent and which preferably is no greater than 1 percent, so that these basic warp yarns are virtually without any crimp.



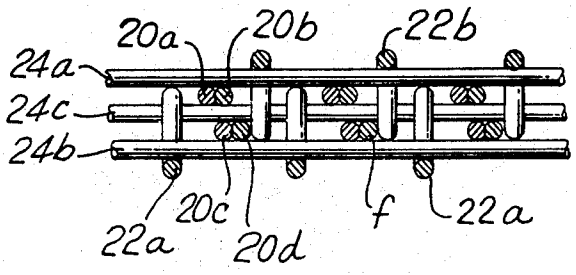


FIG. 1

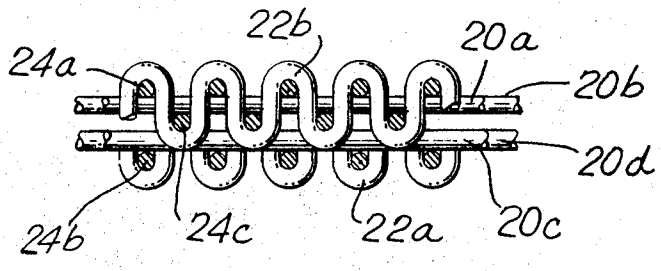


FIG. 2

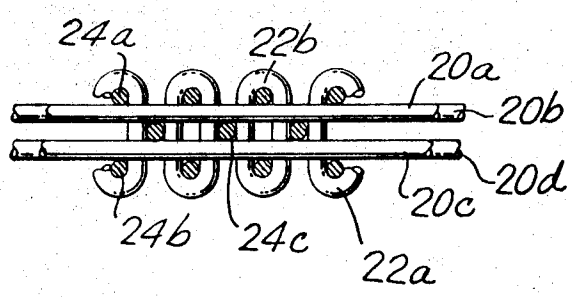


FIG. 3

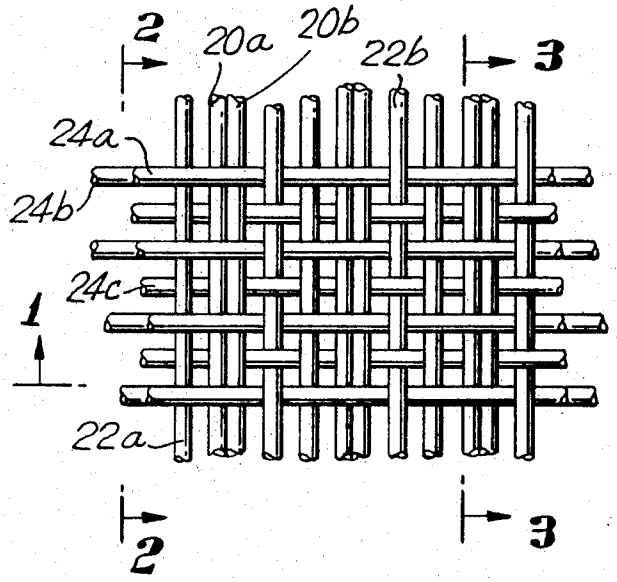


FIG. 4



FIG. 5

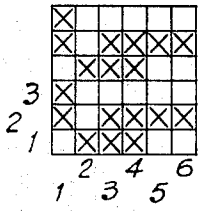


FIG. 6

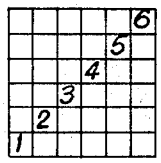


FIG. 8

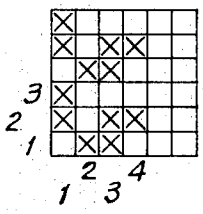


FIG. 7

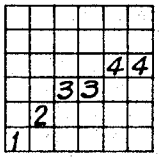


FIG. 9

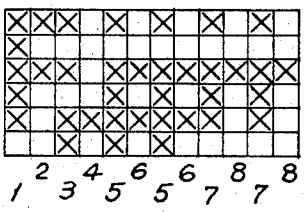


FIG. 11

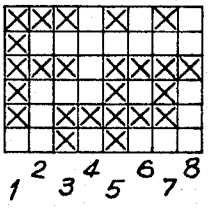


FIG. 10

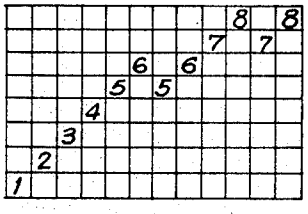
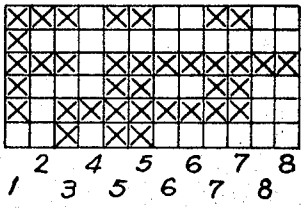


FIG. 12



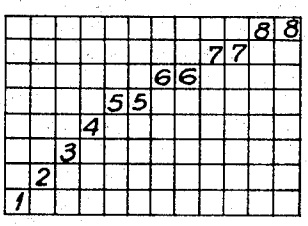


FIG. 13

REINFORCING FABRIC

BACKGROUND OF THE INVENTION

The present invention relates to fabrics capable of withstanding relatively large tensile stresses.

Such fabrics are incorporated into conveyor belts, for example, for reinforcing purposes, or they may be incorporated in tubular form in hose walls to reinforce the latter. Also, they may be used for such purposes as automotive seat belts, for example.

Among the problems encountered with fabrics of this type is the excessive elongation which occurs under load. It is highly desirable to provide a lightweight fabric which will have an extremely small elongation under load, but up to the present time these results have been achieved only to a limited extent. Other problems encountered with fabrics of this type reside in such factors as the provision of a reliable bond between the fabric and the structure which it reinforces.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide a fabric capable of achieving an extremely low elongation under load as compared to similar conventional fabrics.

In particular, it is an object of the present invention to provide a fabric of this type which is of a relatively light weight while still having an extremely low elongation when under load.

Furthermore, it is an object of the invention to provide a fabric the properties of which can be determined by the properties of the yarns which make up the fabric rather than by the manner in which the fabric is woven.

Also, it is an object of the invention to provide a fabric the structure of which lends itself to achievement of an extremely reliable bond between the fabric and material in which it is embedded.

According to the invention, the fabric is composed of basic warp yarns and binder warp yarns as well as weft yarns which extend across the warp yarns. The basic warp yarns of the fabric of the invention have a crimp which is less than 2 percent and which preferably is no greater than 1 percent.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1 is a transverse section of the fabric of FIG. 4 taken along line 1–1 of FIG. 4 in the direction of the arrows;

FIG. 2 is a longitudinal section of the fabric of FIG. 4 taken along line 2–2 of FIG. 4 in the direction of the arrows;

FIG. 3 is a longitudinal section of the fabric of FIG. 4 taken along line 3–3 of FIG. 4 in the direction of the arrows;

FIG. 4 is a schematic, fragmentary plan view of the fabric of FIGS. 1—3, showing the fabric at an enlarged scale;

FIG. 5 is a weave diagram of the fabric of FIGS. 1—4;

FIG. 6 is a harness draft for the fabric of FIG. 5, using six harnesses;

FIG. 7 is a harness draft for the fabric of FIG. 5 using four harnesses;

FIG. 8 is a chain draft for the fabric of FIG. 5 and harness draft of FIG. 7;

FIG. 9 is a weave diagram of a tubular woven fabric of the invention;

FIG. 10 is a harness draft of the fabric of FIG. 9 using eight harnesses;

FIG. 11 is a chain draft of the fabric of FIG. 9 and harness draft of FIG. 10;

FIG. 12 is a weave diagram of a hose fabric using the chain draft of FIG. 11; and

FIG. 13 is a harness draft of the fabric of FIG. 12 using eight harnesses.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIGS. 1—4, the fabric illustrated therein is composed of a group of basic warp yarns **20***a* and **20***b* as well as a second group of basic warp yarns **20***c* and **20***d*. In addition, the fabric has a group of binder warp yarns **22***a* and a second group of binder warp yarns **22***b*.

This fabric of the invention has three groups of weft yarns **24***a*, **24***b*, and **24***c*.

As is apparent from FIGS. 1—4, all of these yarns are woven to form a single ply of fabric with the groups of weft yarns **24***a* and **24***b* being respectively situated at the opposed exterior surfaces of the single ply. These outer groups of weft yarns **24***a* and **24***b* are arranged with the yarns of one of these groups aligned with and situated directly opposite the yarns of the other group to form successive pairs of directly opposed exterior weft yarns, as is apparent from FIGS. 2 and 3. The third group of weft yarns **24***c* respectively alternate with the pairs of aligned weft yarns and are situated inwardly of the exterior surfaces of the fabric.

The group of binder warp yarns **22***a* are interwoven only with the group of weft yarns **24***c* and the outer group of weft yarns **24***b*, while the other group of binder warp yarns **22***b* are interwoven only with the inner group of weft yarns **24***c* and the other outer group of weft yarns **24***a*. Moreover, as is apparent from FIG. 1, the group of binder warp yarns **22***a* respectively alternate with the group of binder warp yarns **22***b*. These alternating binder warp yarns are arranged in successive pairs with the yarns **22***a* and **22***b* of each of the successive pairs of binder warp yarns located directly next to each other.

However, the basic warp yarns **20***a*—**20***d* are situated between the successive pairs of binder warp yarns. These basic warp yarns are arranged with the group **20***a*, **20***b* situated on one side of the group of weft yarns **24***c* between the latter and the outer group of weft yarns **24***a*, while the other group of basic warp yarns **20***c*, **20***d* is situated on the other side of the inner group of weft yarns **24***c* between the latter and the other outer group of weft yarns **24***b*. Between the successive pairs of binder warp yarns, each pair of basic warp yarns **20***a* and **20***b* are located directly next to each other on one side of the group of weft yarns **24***c*, while between successive pairs of the binder warp yarns a pair of basic warp yarns **20***c* and **20***d* are also located directly next to each other. These basic warp yarns are arranged with the basic warp yarns **20***b* and **20***c* on opposite sides of the weft yarns **24***c* situated directly opposite each other while the basic warp yarns **20***a* and **20***d* are situated respectively closer to successive pairs of binder warp yarns than the opposed basic warp yarns **20***b* and **20***c*.

It is thus apparent with the fabric of the invention there are twice as many basic warp yarns as binder warp yarns. Also, in the fabric of the invention the basic warp yarns are situated inwardly of the exterior surfaces of the fabric at a neutral axis of the single ply thereof so that in this way an extremely good flex life is achieved for the fabric of the invention.

Moreover, due to the nature of the weave there will be an extremely good adhesion with an elastomer in which the fabric of the invention is embedded because the elastomer will have free access to the interstices of the weave. The surface of this fabric can be very easily coated and it has a good hook pullout due to the nature of the interlocking type of construction. The fabric of the invention has excellent dimensional stability and has extremely good impact resistance due to the arrangement of the primary or basic warp yarns.

As may be seen from the weave diagram of FIG. 5, there is a repeat on six warps and three wefts. The No. 1 and 2 warps of FIG. 5 respectively correspond to the binder warp yarns **22***b* and **22***a*, while the No. 3—6 warps of FIG. 5 respectively correspond to the basic warp yarns **20***a*, **20***b*, **20***c* and **20***d*. The No. 1 weft of FIG. 5 corresponds to a weft yarn **24***c*, the No. 2 weft of FIG. 5 corresponds to a weft yarn **24***b*, and the No. 3 weft corresponds to weft yarn **24***a*.

The yarns may be straight drawn on six harnesses as indicated in FIG. 6, or they may be arranged in a pattern draw

on four harnesses as indicated in FIG. 7, providing in this way the chain draft indicated in FIG. 8.

FIG. 9 illustrates a weave diagram for a tubular woven fabric of the invention, while FIG. 10 shows a pattern draw for this fabric on eight harnesses and FIG. 11 shows the chain draft for the weave diagram of FIG. 9 and pattern draw of FIG. 10.

FIG. 12 is a weave diagram particularly suited for a hose fabric. The fabric of FIG. 12 is made with the chain draft of FIG. 11 and with a pattern draw of eight harnesses as shown in FIG. 13.

With the fabric of the invention the basic warp yarns 20*a*—20*d* have virtually no crimp. As a result there is an extremely low fabric elongation under load because these basic warp yarns are the load-supporting components. Because of this feature a lesser amount of basic warp yarn is required for a given length of fabric so that an extremely light weight fabric can be produced. The single ply of fabric lends itself to use as reinforcing for single ply rubber or plastic industrial conveyor belting applications.

Examples of fabrics constructed according to the invention have the characteristics indicated in table I, as follows:

TABLE I

	Fabric A	Fabric B
Percent Crimp:		
Warp (Basic)	1.0	1.0
Warp (Binder)	81.0	80.8
Weft	2.6	2.7
Percent Take Up*:		
Warp (Basic)	1.0	1.0
Warp (Binder)	44.8	44.7
Weft	2.5	2.6

*Formula—10" mark in fabric.

$$\frac{\text{Extended Lengths over 10"}}{\text{10"+Extended Length}} \times 100 = \text{Percent Take Up}$$

Three specimens which have the characteristics set forth in table I above were made and tested as indicated in table II, as follows:

TABLE II

[200# Rated Belt Fabric (having approximately 10 to 1 safety factor) Warp-Basic-1,260/4 filament nylon twisted mfg. ×1.5 T.P.I. Warp Binder-840/2 Filament Nylon twisted Mfg. ×1.5 T.P.I. Filling-1260/3 Filament Nylon twisted Mfg. ×1.5. Weave-6 Harness]

Ends/Inch:
Basic—28
Binder—14
Picks/Inch—29.7
Ozs./Sq. Yd.—37.62
Gauge (in.)—0.0190

	Percent, Spec. 1	Elongation, Spec. 2	Warp sample, Spec. 3	1" wide* average
Applied Load at lbs.:				
50	0.5	0.5	1.0	0.7
100	0	1.0	2.0	1.3
200	2.5	2.5	3.5	2.8
400	5.0	5.0	6.5	5.5
600	6.5	6.5	8.5	7.2
800	8.0	8.0	9.0	8.3
1,000	9.0	8.5	10.0	9.2
1,500	10.5	10.5	11.5	10.8
2,000	12.5	12.0	13.5	12.7
Elong. at break (percent)	14.5	14.0	15.0	14.5
Strength at break (lbs.)	2,280	2,350	2,310	2,313

*40 Ends:
2" ravel strip ravelled to 1". Instron Tensile-11" jaw distance.
1"/min. chart and crosshead speed, used Indian Grip Jaws, (Fabric overlaps itself).

It will be noted from table II that the number of basic warp yarns (ends/inch) is twice the number of binder warp yarns, while there were 29.7 weft yarns per inch. Moreover, it will be noted from table I that the weft yarns also have an extremely low crimp which is less than 3 percent and in fact between 2 percent and 3 percent.

As compared with other known fabrics designed to serve similar purposes, a fabric of the invention which is of lighter weight will be elongated to a lesser extent under a given load. Because of the fact that the basic warp yarns are virtually without crimp, the belting fabrics which use the structure of the invention can be produced with properties determined primarily by the individual properties of the warp and weft yarns, rather than by the particular weaving technique which is employed, thus permitting a design which is closer to the exact belt requirements.

I claim:

1. A fabric comprising basic and binder warp yarns and weft yarns extending there across, said basic warp yarns having a crimp of less than 2 percent, the number of basic warp yarns being greater than the number of binder warp yarns, said yarns forming a single ply having opposed exterior surfaces between which said basic warp yarns are located, said weft yarns including a pair of outer groups of weft yarns respectively situated at said exterior surfaces and a third group of weft yarns respectively alternating with said pairs of weft yarns and situated between the exterior surfaces of said ply, some of said basic warp yarns being situated between said third group of weft yarns and one outer group of weft yarns and the remainder of said basic warp yarns being situated between said third group of weft yarns and the other outer group of weft yarns, so that said basic warp yarns are themselves divided into two groups between which said third group of said weft yarns is situated.

2. A fabric as recited in claim 1 and wherein said outer groups of weft yarns form pairs of weft yarns with the weft yarns of each pair situated directly opposite and aligned with each other.

3. A fabric as recited in claim 1 and wherein the number of basic warp yarns is twice the number of binder warp yarns.

4. A belt reinforced with the fabric of claim 1.

5. A tube reinforced with the fabric of claim 1, said fabric being woven in tubular form.

6. A fabric as recited in claim 2 and wherein said binder warp yarns include one group of binder warp yarns interwoven

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,537,488 November 3, 1970

Robert N. Le Boeuf

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

Column 4, after line 45, insert -- only with said third group of weft yarns and one outer group of weft yarns and a second group of binder warp yarns interwoven only with said third group of weft yarns and the other outer group of weft yarns.

7. A fabric as recited in claim 6 and wherein the yarns of said one group of binder warps yarns alternate with the yarns of the second group of binder warp yarns with said binder warp yarns arranged in pairs located directly next to each other and said pairs of binder warp yarns spaced from each other accommodate basic warp yarns between said pairs of binder warp yarns, said basic warp yarns including one pair of basic warp yarns situated on one side of said third group of weft yarns between successive paris of binder warp yarns and a second pair of basic warp yarns situated on the other side of said third group of weft yarns also between successive pairs of binder warp yarns, so that the number of basic warp yarns is twice the number of binder warp yarns with four basic warp yarns following each pair of binder warp yarns.

8. A fabric as recited in claim 7 and wherein each pair of basic warp yarns between successive pairs of binder warp yarns are located directly next to each other with only one of each pair of basic warp yarns on one side of the third group of weft yarns being situated opposite only one of the basic warp yarns on the other side of the third group of weft yarns.

Signed and sealed this 29th day of June 1971.

(SEAL)
Attest:

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Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents