

[54] METHOD OF MAKING AN ELASTIC STITCH-BONDED FABRIC

- [72] Inventors: **Bedrich Weigl; Milos Janku**, both of Dvur Kralove nad Labem; **Milos Prikryl, Zabori; Jaroslav Hubeny, Lipnic; Milos Hofman**, Dvur Kralove nad Labem, all of Czechoslovakia
- [73] Assignee: **Vyzkumny Ustav Zuslechtovaci**, Dvur Kralove nad Labem, Czechoslovakia
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- [58] Field of Search 66/85 A, 192; 28/76 E, 77; 112/413, 414, 427, 428

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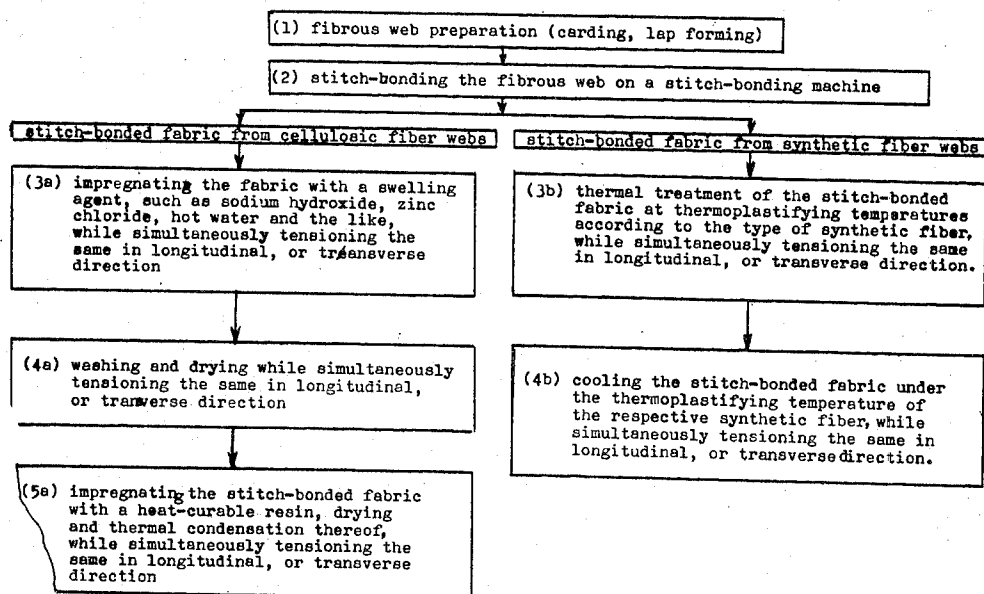
Primary Examiner—Robert R. Mackey

Attorney—Michael S. Striker

[57] ABSTRACT

A fibrous web is stitch-bonded in an atlas construction which is elastic in two directions whereupon the web is tensioned in one direction thereof. The web contracts and is crimped by the stitches in the respective other direction, and is treated to make the crimp permanent so that the finished fabric is expandible in the crimped direction.

12 Claims, 6 Drawing Figures



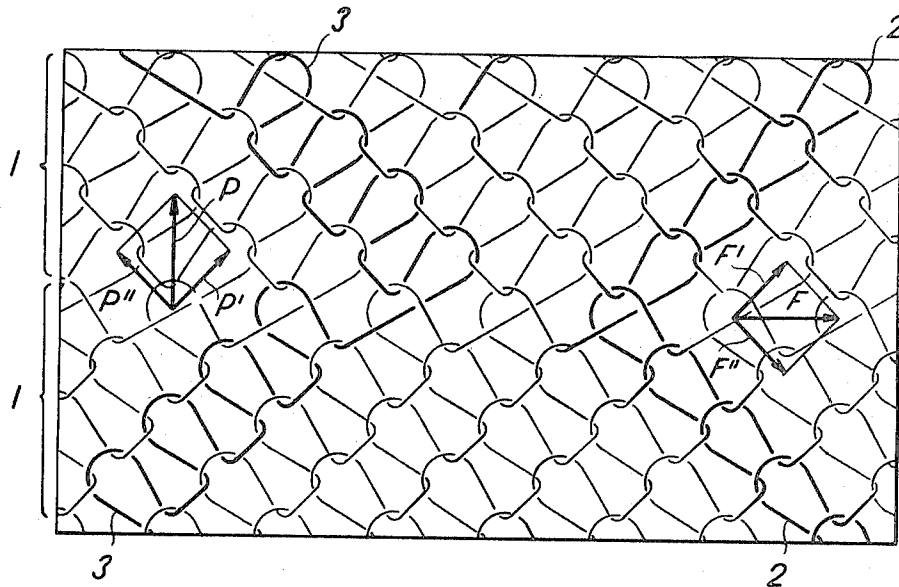


Fig. 1.

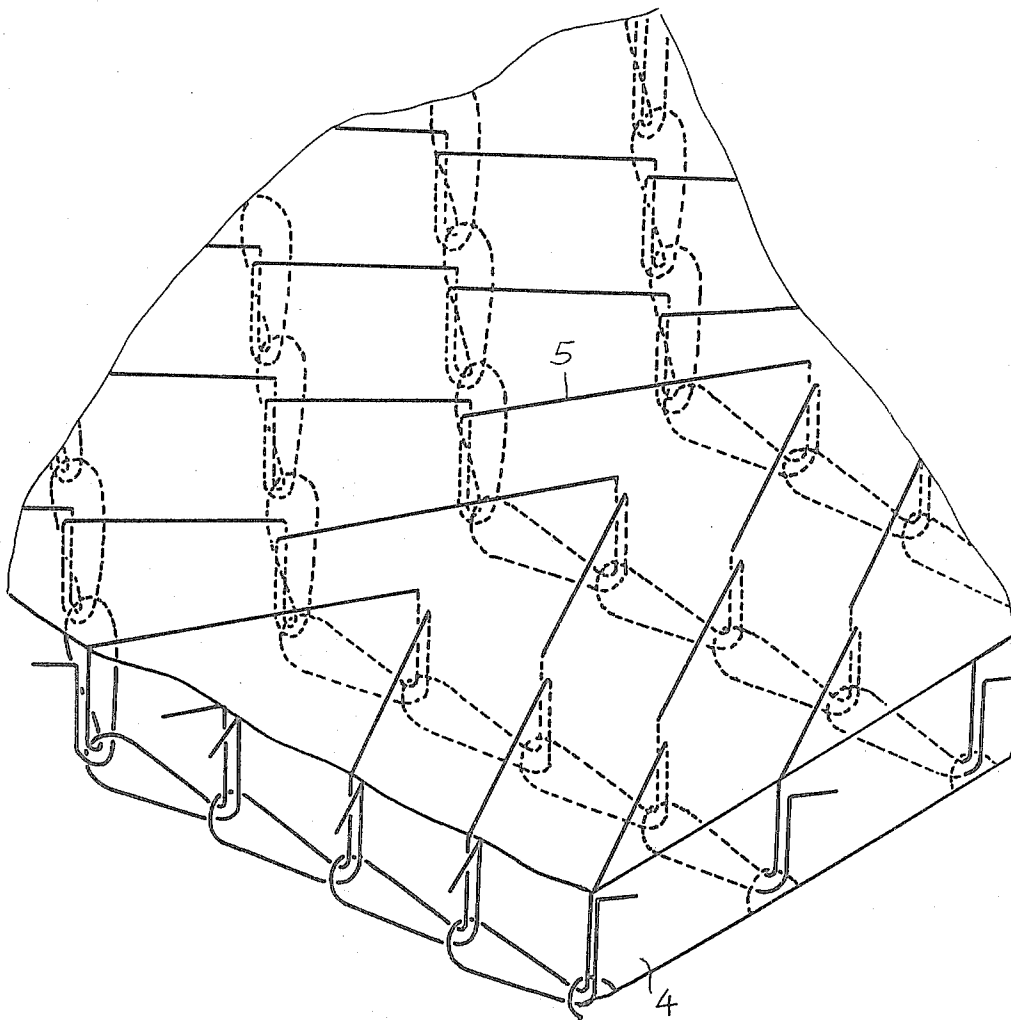
INVENTORS

BEDRICH WEIGL
MILOS JANKU
MILOS DRIKRYL
JAROSLAV HUBENY
MILOS HOFMAN

BY *Michael S. Stucke*

ATTORNEY

Fig. 2



BEDRICH WEIGL
MILOŠ JANKU
MILOŠ PEIKRYL
JAROSLOV HUBENG
MILOŠ HOFMAN
INVENTORS

BY *Michael I. St. Louis*
ATTORNEY

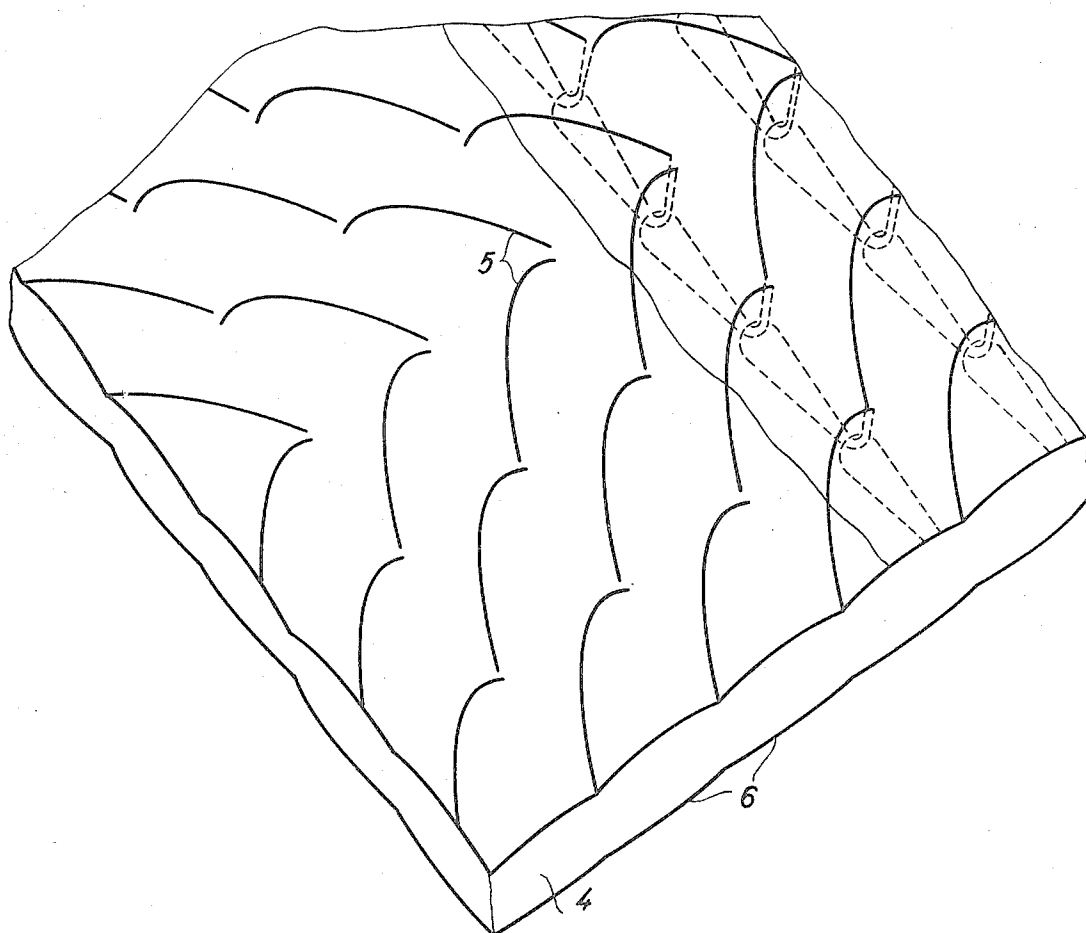


Fig. 3.

INVENTORS

BEDRICH WEIGL
MILOS JANVIL
MILOS POHNYL
JAROSLAV HUBENY
MILOS HOFMAN

BY *Michael S. Sklar*
ATTORNEY

Fig. 4.

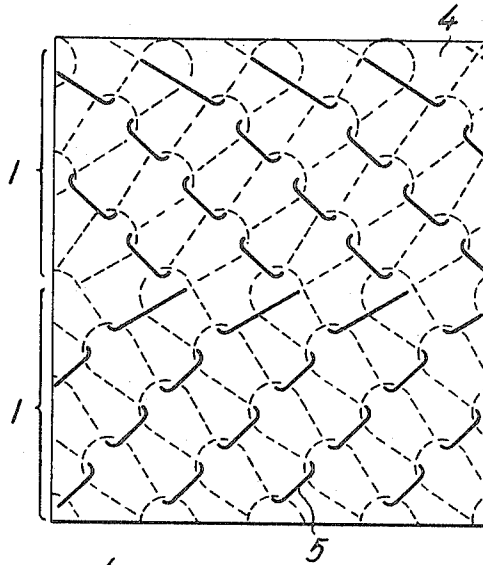
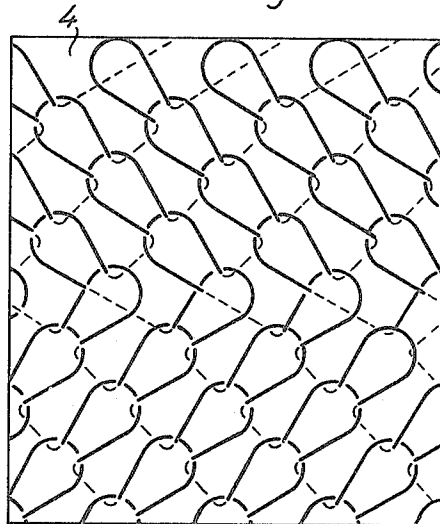


Fig. 5.



INVENTORS

BERICH WEIGL

MILOS JANKU

MILOS PRIKRYL

JAROSLAV HUBENY

MILOS HOFMAN

BY *Michael S. Sklar*
ATTORNEY

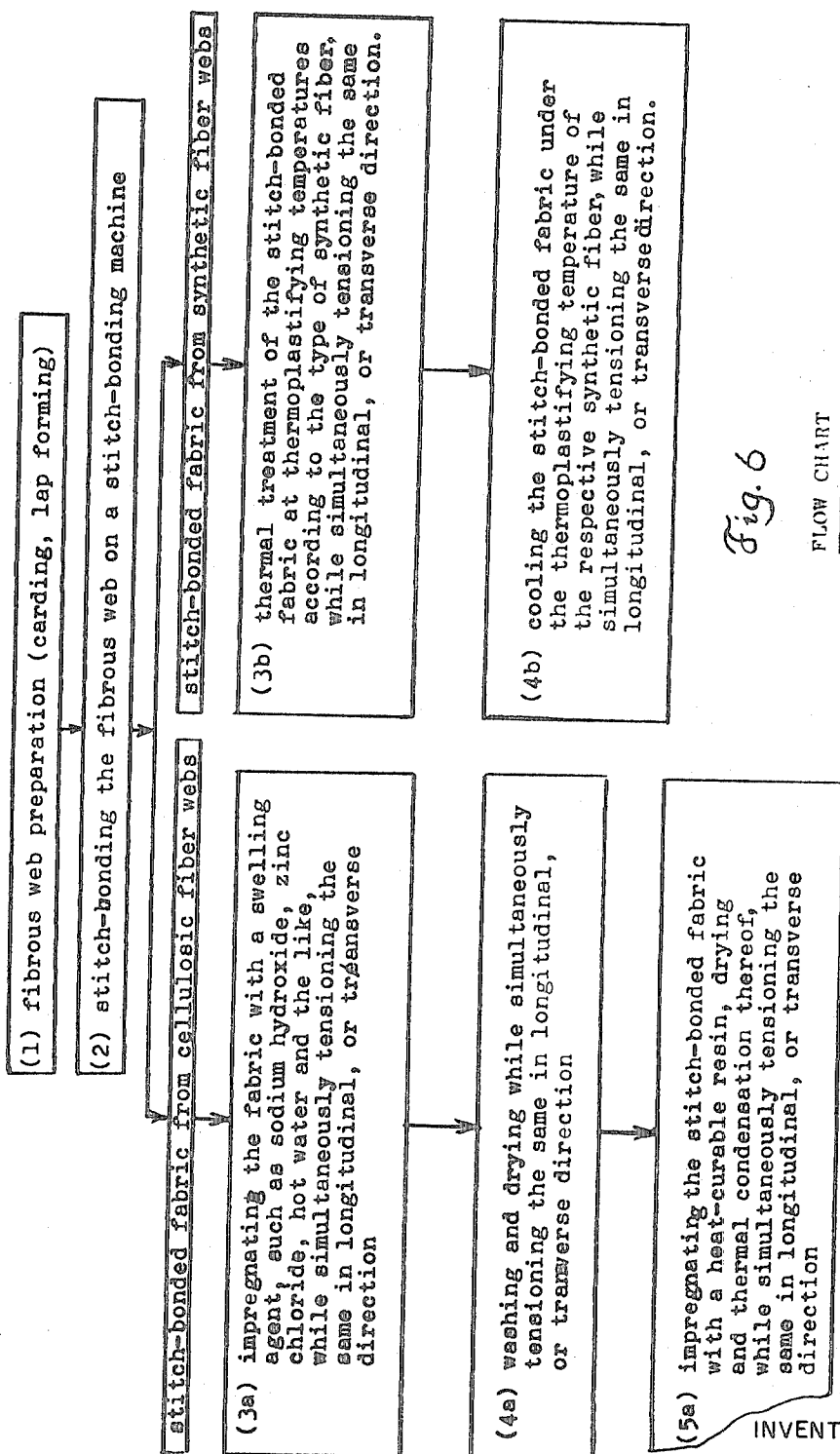


Fig. 6

FLOW CHART

INVENTORS

BEDRICH WEIGL
MILOS JANKU
MILOS PRIKRYL
JAROSLAV HUBENY
MILOS HOFMAN

By: *W. J. J. J.*
ATTORNEY

METHOD OF MAKING AN ELASTIC STITCH-BONDED FABRIC

BACKGROUND OF THE INVENTION

Fabrics are known which are not woven but consist of a fibrous web which is reinforced by stitches of a yarn or thread by parallel seams or knitted construction made on a warp knitting machine. Stitch-bonded fabrics of this type are far less expensive than woven fabrics, but stitch-bonded fabrics according to the prior art are not suitable for clothes due to the low tensile strength of the stitch-bonded fabric in transverse direction caused by the predominantly longitudinal stitch orientation of the reinforcing yarns or threads whose wales are arranged in the longitudinal, so-called warp direction of the stitch-bonded fabric. The tensile strength is considerably lower in transverse direction in which the courses of the warp knitted yarns extend, than in the longitudinal direction of the fabric in which the wales are located. While in the longitudinal direction, the tensile strength of the stitch-bonded fabric depends on the density of the knitted binding system as well as on the tensile strength of the binding threads, the transverse tensile strength of the stitch-bonded fabric depends mainly on the internal friction between the fibers of the web.

As a result, stitch-bonded fabrics have a very low resistance against deformation, and under even low stress, the individual fibers of the webs are displaced relative to each other due to the low friction between the fibers, so that permanent deformations of the fabric take place. For example, if a garment made of a stitch-bonded fabric is subjected to local pressure in the knee, or elbow region, local bulges are formed which are permanent since the displaced fibers have no tendency to resiliently return to the initial position.

It is one object of the invention to provide a stitch-bonded fabric which has greater tensile strength in transverse direction, is highly elastic and consequently suitable for garments.

It is also known to improve the elasticity of fabrics woven on a loom by crimping one of the two thread systems, for example crimping the weft threads while the warp threads are tensioned, or crimping the warp threads while the weft threads are tensioned.

Due to the expansion in one direction, the threads extending in the other direction contract and are treated in this condition with a swelling agent, such as a strong alkaline solution so that the contracted threads, which are clamped between the threads of the respective other thread system, form tightly curved loops. The thus-curved loops are stabilized by treating the fabric with resin precondensates, if the fibers are cellulosic. In the event that the thread system to be crimped includes synthetic fibers, the woven fabric is heat treated at a temperature approaching the molification point of the respective synthetic fibers, while the other thread system is tensioned. After cooling, the treated woven fabric remains shrunk in the direction of the crimped thread system whose loops are set in a sharply curved condition.

Crimping treatment of this kind is disclosed in publications issued by the Imperial Chemical Industries Ltd., Harrogate, Yorkshire, England entitled "H. C. F. Fabrics Based on Crimp Interchange," and in the publication "American Dyestuff Report," issue of July 31, 1967 in an article by William Sloan entitled "Effects of Changes in Fabric Structure on Properties of Cotton Stretch Fabrics."

A disadvantage of crimped woven fabrics is that an interchange takes place between the binding loops so that the crimping and elasticizing effect is limited. Another disadvantage is that the required manufacturing steps are complicated and expensive.

It is another object of the invention to provide a crimped reinforced fabric which is less expensively manufactured than crimped woven fabrics.

SUMMARY OF THE INVENTION

In order to obtain the objects of the invention and to eliminate the disadvantages of the prior art, the present invention provides a stitch-bonded crimped fabric having high elasticity and also sufficient strength and resistance to shape deformations.

A method according to the invention comprises stitch-bonding a fibrous web in a construction or binding having wales in two directions transverse to each other; tensioning the stitch-bonded web in the longitudinal or transverse direction thereof; and treating the fabric to permanently crimp the web in the untensioned direction thereof; so that the web is elastically expandable in the untensioned direction.

Preferably, the construction of the stitch-bonding thread is an atlas binding having alternate strips of oppositely slanted wales. The knitting of an atlas or Vandyke fabric is described in a publication by D. F. Paling, entitled "Warp Knitting Technology," published by the Harlequin Press, Manchester and London.

If the fibrous web consists of cellulosic fibers, such as native cotton or viscose staple fibers, the web is treated by a swelling agent to crimp the web, the crimp is stabilized by a stabilizing agent, and the fabric is then dried.

If the fibers are synthetic fibers, the crimp is set by heating and plastifying the web while the same is tensioned in one direction.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a knitwork bound in a four course open atlas construction;

FIG. 2 is a schematic perspective view illustrating a portion of a web stitch-bonded in an atlas construction, and in untreated condition;

FIG. 3 is a perspective view illustrating the fabric of FIG. 2 in crimped condition after the treatment;

FIG. 4 is a top view of the fabric;

FIG. 5 is a bottom view of the fabric; and

FIG. 6 is a flow chart.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Since in stitch-bonded fabrics, the knitted thread is supported by and passes through the web 4, the atlas construction or pattern is somewhat different from a plain warp knitted fabric. The inclination of the stitches is apparent from the drawings, and particularly FIG. 2 shows inclined loop portions creating the configuration of cross stripes 1.

It is a characteristic feature of atlas knits that transverse stripes 1 are formed wherein the stitches are inclined alternately to the right and left and located in stripes 1 so that the atlas knit appears to be a plain knit having its wales 2 and courses 3 in oblique directions.

Due to the fact that the courses and wales of the atlas pattern do not extend in the longitudinal, or in the transverse direction of the fabric, any force acting on an atlas fabric, for example the force P acting in the longitudinal direction, or a force F acting in the transverse direction, can be divided into two vector components P', P'' or F', F'', respectively, which components extend in the direction of the slanted wales 2, which is the direction in which the knit has its greatest strength. While in other knitting patterns and binding systems, a transverse force acts in the direction of the courses formed by the stitches, in which direction the strength of the knit is very low, the longitudinal and transverse tensile strengths of atlas knits are substantially alike so that an atlas knit is resistant to forces acting in directions transverse to each other.

Consequently, if in accordance with the invention, an atlas warp knit is used for stitch-bonding a fibrous web, the resulting stitch-bonded fabric is elastically reinforced in longitudinal and transverse directions.

An atlas knit construction is characterized by a very high elasticity so that the stitch-bonded fabric, if subjected to a tensioning force, can be stretched in the respective direction, and consequently contracted in a direction perpendicular thereto. The fibrous web is contracted and compressed by the tightened loops of the binding system so that the final product is very elastic. The atlas binding thread system causes a high elasticity of the stitch-bonded fabric not only directly due to the high elasticity of the atlas knitwork but also indirectly since it effects the crimping of the fibrous web which becomes elastic in the crimped direction.

Atlas warp knits are also described in the U.S. Pat. Nos. 2,890,579, 3,310,964, and 2,297,440.

In the method of the invention, a fibrous web is stitch-bonded in a binding having wales in two directions transverse to each other, for example, an atlas binding. The web is tensioned in one direction thereof and left untensioned in the other direction thereof. If the web consists of cellulosic fibers the web is then treated with a swelling agent whereby it is crimped as shown in FIG. 3 and loop portions 5 are curved together with the crimped portions of the web. The stitch-bonded crimped web is washed, and treated by a stabilizing agent so that the crimp of the web is permanently set, whereupon the fabric is dried.

If the fibrous web consists of synthetic fibers, the web is stretched in one direction thereof after stitch-bonding in an atlas binding and is then heated until plastified, and finally cooled whereby the crimp is set. If fibers made of native cellulose, such as cotton are used for the web, the swelling agent is sodium hydroxide which enters into reaction with the cellulosic cotton component. The product of this reaction is alkali cellulose in which the crystallite molecules are spaced from each other. Other compounds having the property of causing the spacing of crystallite molecules from each other, but having a lesser efficiency than sodium hydroxide are:

- a. strong mineralic acid salts, such as zinc chloride, or calcium chloride,
- b. organic solid compounds causing the swelling of cellulosic fibers in a nonaqueous medium, such as urea and thiourea,
- c. organic solvents such as cresol, acetic acid, and formic acid.

For regenerated cellulose fibers, such as viscose staple fibers, water is sufficient as a swelling agent since it renders the fibers softer, more flexible and plastic.

After the swelling of the fibers, the fabric is washed and the swelling agent is removed, whereupon the fabric is dried. Stabilizing agents which may be used can be divided into two main groups:

- a. Reactive precondensate types, such as ethylene, urea, propylene urea, and triazones;
- b. Nonreactive types prepared on the basis of urea or triazines.

A final heat treatment after the fabric has been dried for a period of between 2 and 10 minutes at a temperature of between 120° and 170° C. is carried out.

A web consisting of crossing polyester fibers is preferred, but the fibers may consist of ether synthetic materials, such as polyamide, polyacrylonitrile, polypropylene; and copolymer fibers, consisting of polyethylene terephthalate-isophthalate; polyethylene terephthalate-sulphoisophthalate, polyvinyl chloride-polyacrylonitrile, and polyethylene terephthalate-poly-1,4-dimethylolcyclohexan terephthalate.

The following examples are given as illustrative only without limiting the invention to specific details described in the same.

EXAMPLE I

A cotton web of predominantly transverse fiber orientation having a specific weight of 220 grams per square meter, is reinforced by a 120 denier polyamide filament yarn bound in a four course open atlas binding at a piercing density of 120 per 100 millimeters in longitudinal direction of the web, and on a stitch-bonding machine having a gauge of 40 needles per 100 millimeters.

The stitch-bonded fabric is tensioned and stretched in longitudinal direction and impregnated on a jig with sodium hydroxide concentrated to 34° Be within the range between 25° and 34° Be, at a temperature of 20° C., within the range between 0° and 50° C., while being longitudinally tensioned. The fabric is then washed and dried while being slack in transverse direction. A crimp is obtained in transverse direction which is stabilized by impregnating the fabric on a padding or foulard machine with a bath composed of 200 grams of a 40 percent cycloethylene-urea precondensate solution, 150 grams of a 40 percent dimethylol-urea precondensate solution, and a softener containing a catalyst, per 1 liter. The impregnated fabric is dried and then heated at 150° C., within the range between 120° and 170° C., for a period of 5 minutes, within the range between 2 and 10 minutes. The fabric is then released from longitudinal tension, and is highly elastic in transverse direction, and very resistant to bulging. cl EXAM-
PLE II

A web prepared of viscose staple fibers of 10 denier and having a specific weight of 180 grams per square meter is reinforced by a 150 denier viscose filament yarn bound in an eight-course open atlas binding at a piercing density of 110 per 100 millimeters in the longitudinal direction of the web, and on a stitch bonding warp knitting machine having a gauge of 50 needles per 100 millimeters. The stitch-bonded fabric is stretched in longitudinal direction, and treated as explained in Example I, except that sodium hydroxide concentrated to 7° Be, and within the range between 0° and 7° Be is used. The finished product is elastic in transverse direction and highly resistant to bulging.

EXAMPLE III

The steps and materials are the same as described in the preceding Example I or in the preceding Example II, except that after tensioning of the reinforced web in one direction, a substance or compound other than sodium hydroxide is used as a swelling agent, for instance, water, or solutions of zinc chloride, urea, thiourea, pyridine, acetic acid, cresol, or formic acid.

EXAMPLE IV

A web made of synthetic staple fibers, such as a polyester fiber, and having a specific weight of 180 grams per square meter is reinforced by a thread knitted in a 12 course open atlas binding at a piercing density of 90 per 100 millimeters in longitudinal direction of the web, and on a stitch-bonding warp knitting machine having a gauge of 60 needles per 100 millimeters.

The stitch-bonded fabric is subjected on a fixing frame to a constant tension in transverse direction at a temperature ranging between 150° and 220° C. for a time period of 1 to 2 minutes, whereupon the fabric is cooled in tensioned condition. The obtained fabric has outstanding longitudinal elasticity and a high resistance to bulging.

Fabrics manufactured according to the invention cannot only be used for garments, but also in the manufacture of elastic bandages, coverings for upholstered furniture, wall tapestries, and other applications where woven fabrics have been exclusively used.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of methods of making elastic fabrics reinforced by threads differing from the types described above.

While the invention has been illustrated and described as embodied in a method of manufacturing an elastic fabric of a fibrous web reinforced by threads warp knitted in an atlas pattern, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can be applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. A method of making an elastic stitch-bonded fabric, comprising stitch-bonding a fibrous, nonwoven and nonelastic web in a knitted binding having wales in two wale directions transverse to each other and slanted to the longitudinal and transverse directions of said web; tensioning the stitch-bonded web in one of said directions thereof whereby the stitches of said knitted binding are deformed so that the web is compressed, and crimped in said other direction thereof by deformed stitches of said binding so that bulges are formed in said web, while remaining untensioned in said other direction thereof; and treating said stitch-bonded web while tensioned in said one direction so as to permanently set said bulges and crimp said web in said untensioned direction thereof so that said stitch-bonded web is elastically expansible in said other direction thereof.

2. The method of claim 1 wherein said web consists of cellulosic fibers; and wherein treating of said web includes treating said web with a swelling agent to crimp said web, stabilizing the crimp, and drying the fabric.

3. The method of claim 2 wherein said web consists of cotton fibers; and said swelling agent includes sodium hydroxide

concentrated between 25° and 34° Be.

4. The method of claim 2 wherein said web consists of viscose staple fibers; and wherein said swelling agent includes sodium hydroxide concentrated between 0° and 7° Be.

5. The method of claim 1 wherein said web is made of synthetic staple fibers; and wherein said treating of said web includes heating and plastifying said web.

6. The method of claim 5 wherein said fibers are polyester fibers.

7. The method of claim 1 wherein said web is made of synthetic staple fibers; and wherein said treating of the web includes heating the web to a temperature and for a time to plastify said synthetic staple fibers; and cooling the web.

8. The method of claim 1 wherein said web consists of cellulosic fibers; and wherein said treating of said stitch-bonded web includes treating said stitch-bonded web with a swelling agent to crimp said web, impregnating said web with a solution of a reactive precondensate, and drying said stitch-bonded web.

9. The method of claim 8 wherein said reactive precondensate is selected from the group consisting of ethylene urea, propylene urea, and triazones.

10. The method of claim 1 wherein said web consists of cellulosic fibers; and wherein said treating of said stitch-bonded web includes treating said stitch-bonded web with a swelling agent to crimp said web, impregnating said web with a solution of a nonreactive precondensate, and drying said stitch-bonded web.

11. The method of claim 10 wherein said nonreactive precondensate is selected from the group consisting of precondensates on the basis of urea and triazines.

12. The method of claim 1 wherein said binding has alternate stripes, each stripe comprising wales oppositely slanted relative to the wales of the respective adjacent stripe.

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