Nov. 12, 1946. B. LAWRENCE, JR 2,410,884

COMPOSITE FABRIC

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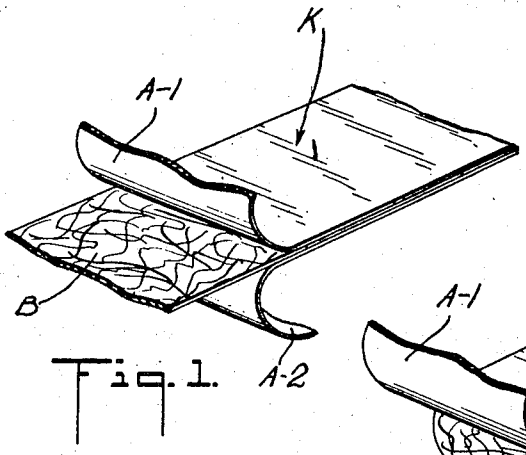


Fig. 1.

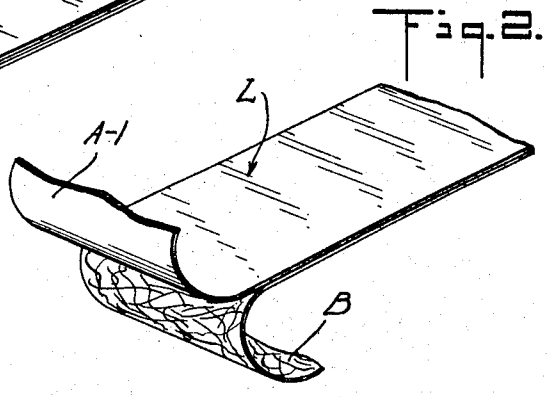


Fig. 2.

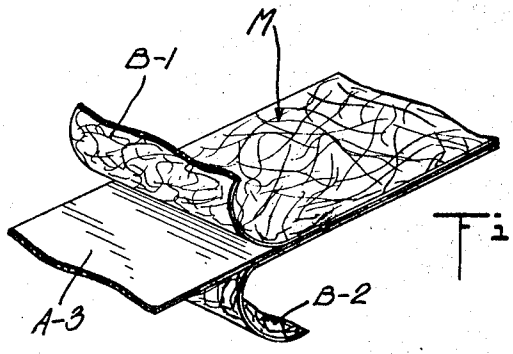


Fig. 3.

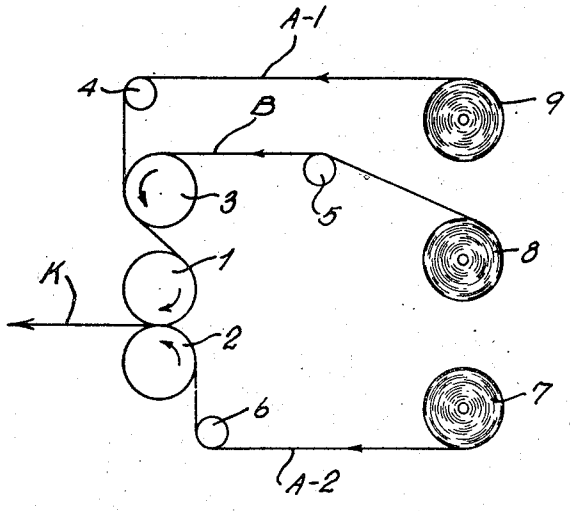


Fig. 4.

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COMPOSITE FABRIC

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4 Claims. (Cl. 154—46)

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This invention relates particularly to fabrics comprising open texture web of heterogeneously distributed strands bonded together at intersections thereof and another web or webs of loosely arranged unspun long fiber that are bonded to the strands of the first web to form an integral tough sheet.

It is a purpose of this invention to provide a fabric which has good tensile strength, good resistance to tear but which is not excessively stiff or leathery and in which smooth fine surfaces are provided.

It is a further purpose of this invention to provide stout fabric that is inexpensive to produce and that is capable of a variety of uses particularly where strength, toughness, flexibility and smooth fine surfaces are required.

Generally speaking, according to this invention, fine closely laid unspun fiber webs of cotton or other like fibers having a length of from 3/8" to 5/8" fiber lengths formed by carding or garnetting and weighing from 200 to 400 grains per yard and having a thickness of from 2 to 8 fiber diameters, or split starched wadding are combined with loosely, and openly or heterogeneously laid fiber webs of sisal, jute, pita or other like fibers which have been formed by garnetting or carding to form fabric meeting the purpose of this invention. The threads, fibers or strands in the heterogeneous web may be from 3/4" to 4" long as contrasted with the 3/8" to 5/8" long fibers in the unspun web. The weight of the latter web may vary according to the material used; the approximate weight of sisal may be from 12 to 20 oz. per square yard but greater or lesser amounts can be used depending upon the strength desired in the finished fabric. The unspun and heterogeneous webs may be impregnated with the same or different binders or only the heterogeneous web might be impregnated with a binder and unspun webs adhered thereto simply by the stickiness of the impregnant on the heterogeneous web.

The unspun webs of long fibers thus arranged with the fibrous strands afford numerous advantages and improvements. Thus, it is a feature and advantage of integrated strand fabrics embodying this invention that strains become distributed over a maximum number of the fibers with the effect of greatly increasing the load-bearing properties of the fabric. Tensile strains are taken predominantly by the heterogeneously distributed strands, and the unspun web structure with which the strands are integral enables such strains to be distributed over a plurality of strands so that the tendency to rupture is minimized. Moreover, tear strains also are taken predominantly by the strands and in this case, also, the unspun web material of loosely bonded long fibers augments the tear

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resistance of the individual strands and permits yielding of the individual strands with distribution of the tear strains to a plurality of strands thereby providing very high tear resistance. The structural combination, moreover, is pliant and easily flexed.

Strand fabrics embodying this invention have a variety of uses, being suitable in some forms for packaging of vegetables and fruits, in others, when waterproof for tarpaulins and the like, as substitutes for burlap and for various other uses.

Any fibers of the character described in the unspun web whether of cotton or otherwise are referred to herein as "long" fibers in order to distinguish such fibers from paper stock and the like. However, it is an advantage of this invention that relatively inexpensive low grade fibers may be used. Such fiber may be animal, vegetable, synthetic or mineral. Examples of suitable fibers are hair, wool, bast fibers, musa fibers, asbestiform fibers, rayon, cellulose, synthetic fibers, etc. In any event, the fibers used in the unspun fibrous web material are "long fibers" as this term has been defined above. Moreover, while the fibers are ordinarily bonded together in the webs they are nevertheless disposed in a loosely matted relation as distinguished from a dense compacted and rigid mass or sheet of fibers such as short fibers formed on a paper-making screen or densely felted fibers. When the fibers in the unspun fibrous web material have been subjected to a carding machine action they have a very desirable condition of indiscriminate interlacing and curvature of individual fibers which renders the web material stretchable and yieldable without rupture in any direction.

With regard to the strands, other fibers than the heavy sisal, jute and the like fibers can be employed. Thus, animal, vegetable, mineral or synthetic fibers such as those mentioned above may be employed. The fibers may be made into rovings which either are unspun or slightly twisted. When it is stated herein that the fibers in the strands are "bunched" it is to be understood that the fibers are arranged contiguously either in unspun relation or in a loosely twisted relation as distinguished from fibers in highly twisted and dense types of cord. It is not without the scope of this invention to use more highly twisted strands such as various types of fibrous cord material. If the strands are tightly spun, it is difficult to impregnate the fibers at the centers of the strands thoroughly and this renders the unimpregnated fibers subject to deterioration by moisture. When the fibers are initially impregnated they contain about 100% to about 200% of bituminous or other like binder based on the weight of the fibers in the strands or rov-

ings. Preferably, though not necessarily, the strand elements are of larger diameter than the long fibers.

Having thus indicated in a general way the nature of this invention, further purposes, features and advantages of this invention will be apparent in connection with the following description of certain typical embodiments which are described for exemplary purposes in connection with the accompanying drawing, wherein:

Fig. 1 is a perspective view, largely schematic, of integrated strand fabric embodying this invention;

Fig. 2 is a perspective view, largely schematic, of an alternative embodiment of this invention;

Fig. 3 is a perspective view, largely schematic, of another alternative embodiment of this invention; and

Fig. 4 is a schematic view illustrating the steps of combining unspun long fiber-bearing webs with strand webs to produce various of the embodiments shown in Figs. 1 to 3 inclusive.

The unspun web A of cotton fibers of 3/8" to 5/8" fiber length of the character described is made into web form using a conventional carding or garnetting machine. These webs weigh from about 200 to about 400 grains per square yard and have a thickness of from 2 to 8 fiber diameters. The web thus produced is in the form of a thin matted mass of irregularly interlaced long fibers loosely arranged.

Suitable loosely matted webs of long fibers can also be made in other ways such as by making garnetted wadding which may, for example, be composed of cotton fibers about 3/8 inch to about 5/8 inch in length. Thus, for example, garnetted wadding containing about 400 grains per square yard may be lightly starched on opposite sides and then split midway the thickness thereof. The soft fibrous surface at the plane of the split is then used on the inside adjacent to the strand elements. In such case, the starched surfaces make the web material easier to handle while the soft inner surface is suitable for surrounding and maintaining in position the strand elements of the fabric. The starched surface of the wadding does not materially interfere with the impregnation of the composite fabric and tends to make the outer surface of the fabric have less stickiness.

A web B of coarse, loosely heterogeneously and openly laid fiber webs of sisal, jute or other like fibers which have been formed by carding or garnetting, is also prepared. The fibers or strands in this web B are from 3/4" to 4" long as contrasted with the 3/8" to 5/8" fibers in web A. The weight of this web B varies with the material used. The approximate weight of such a web when made from sisal would be from about 12 to about 20 ounces per square yard. Greater or less amounts can be used depending upon the strength desired in the finished fabric.

The fabric may be constructed by using various combinations of webs A and B.

In a prefered form of fabric K a web B is sandwiched between two webs A—1, A—2 as shown in Fig. 1. The fabric K may be formed in the manner illustrated in Fig. 4. In the latter, 1 and 2 represent a pair of heated pinch rollers and 3, 4, 5 and 6 represent idler rollers. A roll 8 of the material of web B saturated with binder and rolls 7 and 9 of the material of webs A—1, A—2 are provided.

The webs A—1, A—2 of rolls 7 and 9 may be unsaturated before being combined with the web B. The latter may be saturated with or coated with a thermoplastic binder such as a bituminous resinous or other binder, having a softenting point between about 140° F. and 160° F. This binder may be applied to the web B by spraying onto the web, dipping the latter into the binder or else the binder may be applied in other manners such as with printing rolls or doctor blades. The binder serves to bond the strands at their intersections.

The saturated web B is unrolled from roll 8, passed over idler roll 5 and around roll 3. Similarly, a web A—1 is unwound from roll 9 and passed around idler roll 4 to roll 3 where it engages a face of web B. The combined webs A—1 and B pass around roll 1 and between the latter and roll 2. Also, a second web A—2 is unwound from roll 7 and passed around roll 6 and around roll 2, passing between it and roll 1 and engaging the opposite side of web B from the web A—1. The combined webs A—1, B, A—2 pass between the pressure bight of the heated rollers 1 and 2 producing the finished fabric K of Fig. 1.

While the webs A—1 and A—2 may be unsaturated before being combined with the web B as just described, they also (although this is not preferred) may be previously saturated with the same or similar binder used for web B, or they may be saturated with binders unlike the binder used with web B, such as latex, starch, cellulose or vinyl resins or the like. Also, the webs A—1, A—2 may be left unsaturated until after their combination with web B, and then the whole fabric K may be saturated or coated with latex, oils, resins or other plastics preferably of the non-thermostatic class.

In a further alternative the webs A—1, A—2 may be peptized so as to cause the fibers thereof to adhere and in effect become welded together and thereafter causing the peptized substance to harden. For example, a peptizing agent such as zinc chloride or sulphuric acid may be used which has the effect of gelatinizing cellulosic fibers such as cotton fibers so that the fibers will adhere together. Preferably, only the surfaces of the fibers are peptized so that after the fibers have become adherent and set, the resulting fabric will not be excessively stiff. After the fibers have been sufficiently peptized, the peptizing agent is removed, e. g. by washing or neutralization and the fibers are permitted to set in situ in bonded relation to each other. The impregnated strands of the web B are not affected by the peptizing agent and are encased between webs A—1, A—2 which are substantially free of the bituminous or other binder. Such structure is especially desirable when the fabric is to be used in connection with an article which is to be maintained out of direct contact with the bituminous or other binder material that is used in the heterogeneous strands of web B. If the fibers are synthetic such as rayon, cellulose, acetate, etc., a suitable solvent can be used as the peptizing agent, e. g. acetone, and it can be removed by drying which may be accelerated by heating or by washing out.

Another way of accomplishing the bond between these webs A—1, B and A—2 is to coat the sides of webs A—1 and A—2 that will come in contact with the web B in the operation of Fig. 4, with the same thermoplastic material as would ordinarily be used to saturate the web B, and leave web B unsaturated and uncoated and combine the so-treated webs A—1, B and A—2 with the heat and pressure in the apparatus of Fig. 4.

By omitting the roll 7 from the apparatus of

Fig. 4 bearing web A—2, the fabric L of Fig. 2 is produced which consists simply of a combined web A—1 and a web B. The web A—1 of this fabric L may be treated in any of the ways of the web A—1 described in connection with the fabric K.

In the completed fabric K or L, the web B, by reason of its fibers or strands being longer and stronger than those fibers used in webs A—1 and A—2, provides the strength. Webs A—1 and A—2 by virtue of their fibers being fine and closely laid, provide sheets which hold the fibers of web B in place and also provide a fabric with a smooth fine surface which is desirable. Furthermore, the webs A—1 and A—2 act as barriers to the seepage of the thermoplastic binder used in web B. As thermoplastic binders must be necessarily of low softening point, i. e. between about 140° F. and 160° F. when used in fabrics which are designed to be flexible, the binder under warm conditions, often stains or discolors articles coming in contact with the fabrics. If the coating or saturant used on webs A—1, A—2 is preferably non-thermoplastic and, preferably, non-compatible with the binder used in web B, this seepage is eliminated.

Sufficient binder material of the appropriate kind may be used either in webs A—1, A—2 or B to make the fabric moisture proof or resistant to gases and chemicals (depending upon the type of binder) or a lesser amount may be used to make the fabric porous.

Another modification of this invention shown in Fig. 3 may be prepared with the apparatus of Fig. 4 by substituting rolls bearing respectively webs B—1 and B—2 of the material of web B for the rolls 7 and 9, and by substituting a roll bearing a web A—3 of the same material as web A for the roll 8. The resulting fabric M of Fig. 3 consists of a web A—3 sandwiched between the webs B—1, B—2 of heterogeneously distributed strands. The webs B—1, B—2 and A—3 as well as the resulting fabric M may be treated in any of the ways previously described with respect to the webs A, B and the fabrics K and L.

The fabrics K, L or M produced according to this invention have great toughness and tear resistance as a result of the special coactions whereby the fibers of the weaker web or webs wrap about and yieldably hold the strands of the stronger web or webs providing a fabric which as a whole is yieldable without tearing. These fabrics are unlike so-called reinforced papers wherein the paper sheets have short fibers reinforced by adherent fibers. In such paper, the paper backing sheets are relatively stiff, dense, brittle and unyieldable. The reinforced paper does not have the high degree of toughness of fabrics made according to this invention. The short fibers of the paper do not wrap about the strands of the reinforcing fiber. The strands on reinforced paper, therefore, strip off easily. In contrast, the fabrics K, L and M have their strands enwrapped by fibers and hold together very well and, insofar as toughness is concerned, manifest a resistance to sudden strains that is much greater than the sum of the strengths of the individual webs of the fabrics. The enwrapping of the strands by the fibers appears to introduce a multiplying factor. In some fabrics embodying the invention the strength of the fabric has been found to be as much as twenty times the sum of the strengths of the individual webs. This is a very important attribute of fabrics of the invention. For example, if such fabrics are used for bag material, the added strength makes such bag material highly resistant to sudden strains incurred as by dropping of a filled bag which would cause ordinary bags to split open. Bags embodying the fabrics of the invention do not split open when dropped because of the fabrics' great toughness and resistance to tear in all directions.

While this invention has been described in connection with certain specifific embodiments thereof, it is to be understood that this has been done for illustrative purposes only and that the practice of this invention may be varied within the scope thereof as defined by the language of the following claims.

What is claimed is:

1. A composite fabric comprising an open texture web of heterogeneously distributed strands saturated with and bonded together at the intersections thereof by a thermoplastic binder and another web of loosely arranged unspun long fibers that are bonded together by a non-thermoplastic binder that is non-compatible with said thermoplastic binder, and that are bonded to the strands of said first web to form an integral tough sheet, said strands of said first web being of substantially greater tensile strength than the fibers of said second web, and the fibers of said second web being arranged in closer texture than the strands of said first web and preserving the structural integrity and strength of said first web, and said strands being of larger diameter than said fibers.

2. A composite fabric comprising an open texture web of heterogeneously distributed strands saturated with and bonded together at the intersections thereof by a thermoplastic binder and another web of loosely arranged unspun long fibers bonded to said strands by said binder and bonded together by a non-thermoplastic binder that is incompatible with said thermoplastic binder to form an integral tough sheet, said strands of said first web being of larger diameter, of greater length and of substantially greater tensile strength than the fibers of said second web, and the fibers of said second web being arranged in closer texture than the strands of said first web and preserving the structural integrity and strength of said first web.

3. A composite fabric comprising a web of unspun long fibers and adherently bonded to the fibers of said web a multiplicity of strands having greater tensile strength than the tensile strength of the fibers of said web, said strands occurring in a condition of heterogeneous distribution, the said strands being saturated with a thermoplastic binder and the said fibers being saturated with a non-thermoplastic binder that is non-compatible with said thermoplastic binder.

4. A composite fabric comprising a pair of webs each of uniform long fibers and adherently bonded to the fibers of each of said pair of webs and between the latter a multiplicity of strands having greater tensile strength than the tensile strength of the fibers of said pair of webs, said strands occurring in a condition of heterogeneous distribution, the said strands being saturated with a thermoplastic binder and the said fibers being saturated with a non-thermoplastic binder that is non-compatible with said thermoplastic binder.

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