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J. F. PALMER

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FIBROUS SHEET

Filed Sept. 4, 1928

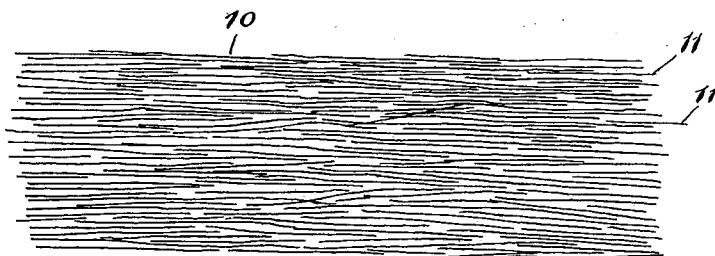


Fig. 1

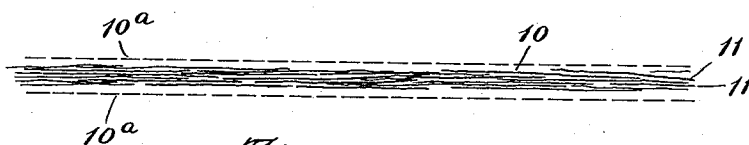


Fig. 2

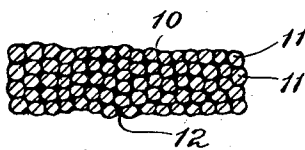


Fig. 3

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FIBROUS SHEET

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This invention relates to sheet or strip material composed mainly or wholly of unspun, unwoven, cotton or other fibers in substantially parallel relation, together with a suitable binder, preferably of an elastic nature such as rubber.

My object is to provide a sheet, web or fabric of this nature whose tensile strength in a longitudinal direction shall be nearly or quite equal to the combined tensile strength of the individual fibers, a result which heretofore has never been attained so far as I am aware. In thread fabrics, for example, the strength of the individual twisted threads made by ordinary spinning and doubling processes is never more than about 55% of the strength of the fibers composing the thread, whereas, by my present invention I am enabled to obtain a sheet or web possessing approximately 85 to 100% of the strength of the fibers composing it.

In practicing the invention in its preferred form, I take a flat sliver of loose cotton fibers which by carding, combing or analogous processes have been brought into a nearly parallel relation longitudinally of the strip, and apply the binder thereto in a liquid form. While various agglutinants or binders might be employed, rubber is preferred for general purposes in a flexible fabric, and this may be applied either as a so-called solution, in a rubber solvent, or as a water emulsion or dispersion such as natural or artificial latex having the well-known advantage of freedom from fire hazard and loss of valuable solvent. I prefer to apply the binder by passing the sliver through a bath of the liquid containing said binder, although it may be applied in other ways as by spraying.

While the present invention may be performed with various types of apparatus, it is desirable to confine the ribbon of fibers by engaging it on both sides with a series of pairs of closely-spaced rollers, partly or completely immersed in the bath, and propelling it by means of said rollers while passing through the bath. In this way successive increments of rubber particles are deposited upon the fibers to form a thin coating which envelops

said fibers and binds them together in a cohesive web. On emerging from the bath, the coated fibrous web is passed between a pair of squeeze rolls to press out the excess of liquid therefrom.

After the excess of water has been removed, the fibrous ribbon is passed over a series of heated rollers in order to evaporate the remaining moisture therefrom, one or more air blasts being employed to assist in the drying action if desired, and finally the ribbon may be passed over one or more cold rollers through which cold water is circulated. Between the squeeze rolls and the first pair of drying rollers, and between each successive pair of drying and cooling rollers, the ribbon is drawn or stretched out by driving each succeeding pair of rollers at a slight increase of peripheral speed over the next preceding pair, for the purpose of progressively straightening the fibers and getting them more nearly into a parallel relation than they occupied in the sliver. Cotton as well as many other fibers in their natural condition are not straight but more or less wrinkled, wavy, or curved in one or more planes and they have more or less of this form even when combed into approximately parallel relation. If bound together with rubber or other agglutinant and dried while in this wavy condition the strength of the resulting web will not be nearly as great as the combined strength of the individual fibers, probably on account of the fact that some fibers are straighter than others and these tend to break first and thus produce a progressive disruption of the sheet under longitudinal strain. When, however, the sheet or ribbon is pulled or drawn out and maintained under tension until the binder is sufficiently set thereon to hold the fibers in their straightened condition, the breaking strength of the product will approximate the combined strength of the individual fibers.

Inasmuch as rubber and other binders applied in liquid form tend to contract when dried and cooled, and my process as thus far described does not permit of the longitudinal contraction of the binder, I prefer to diminish the rate of drawing out of the rib-

bon between successive pairs of drying and cooling rollers by imposing a decreasing increment of peripheral speed of the latter pairs of drawing and drying or cooling rollers over the next preceding pair and thus avoid imposing a breaking strain upon the ribbon during the process of forming.

Of the accompanying drawings, Fig. 1 is a magnified plan view showing approximately the condition and relation of the fibers in a narrow strip of my improved material.

Fig. 2 is an edge view showing in full lines the strip in its pulled-out condition, and in broken lines the increased thickness it would tend to assume if the tension were relaxed before setting the binder upon the fibers.

Fig. 3 is a greatly magnified cross-section of the strip showing conventionally the fibers and the binder thereon.

In the drawings, 10 is a strip of cotton or other fibers 11, 11 in approximately parallel relation and in the straightened condition imposed by drawing out the strip while drying and setting the binder thereon in the manner above described. In Figs. 1 and 2 the binder is omitted for clearness of illustration but is represented at 12 in Fig. 3 as a thin coating which envelops the individual fibers and binds them together in a cohesive web.

If the tension were relaxed while the strip is still wet, the fibers would more or less resume the wrinkled or wavy condition which they have in their natural state, and the strip would tend to assume an increased thickness represented by the broken lines 10* in Fig. 2. If dried in this condition, the material would not possess that high degree of tensile strength which I desire to obtain, but by drying and setting the binder while the strip is maintained under tension as above described the fibers are held straight and permanently remain so in the finished product, with the result that I obtain a practically inextensible material possessing approximately 85 to 100% of the combined strength of the individual fibers.

It will be understood that the thickness of the material may be varied by starting with a thicker or thinner sliver and also by overlaying two or more slivers during the process of forming the material or by plying up two or more of the finished strips.

The strength of the material does not depend upon the length of the fibers, and short-staple cotton or other fibers may be used, but for convenience in handling a cotton fiber it is preferred to employ a staple length of about one and one-quarter inches.

Where a rubber binder is employed it may be used either with or without a vulcanizing agent.

While the foregoing is given as a preferred mode of carrying out the invention, it will be understood that various changes may be made in the character and relation of the

steps within the scope of the appended claim. Fibers of various origins, and different kinds of binder of either single or mixed composition may be employed.

A web or fabric having the described characteristics is useful for many purposes including balloon envelopes, airplane coverings, belts and belting, hose, pneumatic tires, etc. Transverse strength is obtainable by laying plies of this fabric in adhesive contact with the fibers of one ply lying across, at a right angle or other angle to those of an adjacent ply. The fabric may be used with other materials, and if a thread possessing some longitudinal elasticity is desired, a narrow strip of the fabric may be twisted upon itself, either with or without a core such as soft rubber.

I claim:—

The method of making strip material which comprises applying a liquid binder to a strip of loosely-arranged fibers, progressively drying the strip, and progressively elongating the strip in successively decreasing increments while so drying it, to straighten the fibers and hold them permanently in that condition while the binder is being set thereon.

In witness whereof I have hereunto set my hand this 1st day of September, 1928.

JOHN F. PALMER.