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METHOD OF INCORPORATING FIBER AND RUBBER COMPONENTS

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The particular object of my invention is the introduction into the manufacture of rubber-fiber assemblies of the type of fiber generally designated as "bast fiber." At present, such fibers are not considered acceptable because of the low torsional test which constitutes their greatest disadvantage. Otherwise they would be not only acceptable but an advance over the cotton now universally employed.

The fiber of flax and of ramie is far stronger than that of cotton as is witnessed by the superiority of linen thread over cotton thread and the superiority of flax papers and ramie papers over an all-rag sheet based on cotton fiber. Nevertheless, the low torsional strength of these excellent fibers preclude their use in rubber in the form of fabric or of cords.

Where strength is a cardinal property the use of woven fabrics has been all but discontinued due to the rapid destruction of the yarn at the points of intersection with one another where no separating rubber can be interposed. The use of cords eliminated this difficulty but introduced another, namely, the need for a very strong twist. This demand virtually eliminates the compound bast fibers from consideration giving the pre-eminent place to the unicellular cotton or to its derivative, rayon.

But on the other hand the use of cords does not eliminate fiber to fiber contact within the cord and the strong twist prevents the penetration of rubber substance into the interior of the cord. Furthermore, such layers of cords as are now universally introduced are excellent insulators against heat and thus prevent the dissipation of the heat generated within say a tire in operation at high speed.

It cannot be questioned that the introduction of a stronger fiber with a correspondingly thinner wall would constitute a further improvement in a tire and a very desirable one. The recent practice of introducing expensive rayon instead of cheap cotton into rubber in order to get a somewhat smoother, thinner cord is an eloquent testimonial to the need for improvements in this direction.

But even cheap cotton becomes an expensive commodity when it has passed through the various steps needed to convert it from a loose mass of seed hairs into a finished cord. With bast fibers the economic situation is even worse for the spinning of the long straight bast fibers is about twice as costly as the corresponding operation upon cotton. Finally, the first cost of bast fibers is far greater than that of cotton so viewed

from every angle the employment of bast fibers is beset with difficulties.

A very simple solution is nevertheless possible. If short fibers be substituted for long ones and if these be arranged in a water suspension in a rough state of parallelism by an adaptation of the paper maker's art to achieve something the very reverse of paper making, then it becomes possible to introduce rubber in the dispersed phase into such a fiber arrangement and produce a rubber-fiber complex which answers all requirements both from the economic and the technical angle.

The substitution of a short for a long fiber solves entirely the economic aspect. The production of such a fiber from seed flax straw, now virtually a waste of great magnitude, presents no difficulty although long fibered spinning flax is not and probably cannot be produced from such a source. To some extent the use of such short fiber from this source in papermaking has been attempted but the production of a clean sheet is all but impossible. It will be self-evident that the presence of tiny specks, such as would be prohibitive in paper, would be of no moment in a rubber mix.

Any amount of ramie could likewise be grown for the direct production of fiber, and if only a short fiber were sought no technical difficulty would be encountered. In either case a simple cook with mild alkaline agents, suffices to liberate the bast fiber from the woody stalk, and a sufficiently clean separation for the rubber maker can then be effected by the simplest of mechanical means. Sodium carbonate and/or sodium sulphide are particularly adapted to such cooking methods which are well known in industry so they will not be further described herein.

By the term "short fiber" as used above is meant a length of less than $\frac{1}{2}$ inch, longer stock than that becoming too troublesome to work by the means now to be described. It may appear at the first glance as this relegates my method to plain paper making with the introduction of dispersed rubber, but such is far from being the case. Paper is a felt made from cellulose fiber, its coherence into a sheet depends upon proper preparation by beating prior to forming into such a sheet. Such beating necessarily destroys the strength of the individual fiber but it tremendously increases the strength of the finished paper by increasing the felting power of the fibers.

Furthermore, it is essential in a sheet of paper that the fibers be crossed regularly in all directions, and to achieve this object the side shake

of the Fourdrinier and the equivalent attachment on the cylinder machine were invented. It is a known fact that in a smooth flowing current of diluted pulp the fibers tend to arrange themselves in a direction parallel to the flow. The tendency is the same that may be observed in a raft of logs flowing with the current down a river, the logs taking a position parallel to the banks.

Paper making may thus be looked upon as a combination of means to hydrate, soften and generally macerate fibers followed by means to thoroughly entangle these with one another and to arrange them in a regularly interlaced position, the reverse of parallelism. As I employ neither of these procedures it follows that the "web" produced by my process is in no sense "paper" but a sheet of layered fibers in which as high a degree of parallelism as possible is the object sought.

The short fibers are, therefore, suspended in water and allowed to flow for some distance before they meet the paper machine wire, care being taken throughout to eliminate every item that might introduce cross currents and thus cause transverse felting. It is, of course, impossible to eliminate it entirely but the aim is to keep it as low as possible.

As such a web has but little lateral strength and splits almost at a touch it is desirable to add rubber in some dispersed form to the fiber suspension and thus create enough adhesion to facilitate subsequent operations. Such dispersed rubber may also be pigmented and contain additive materials required in vulcanization at the discretion of the operator.

Having obtained in this manner a primary web then it may be further layered by wrapping upon a mandrel until it has obtained the requisite thickness, being then cut and taken off in sheets as upon a wet machine. Or the primary webs from a series of wires may be superimposed upon one another to reach the desired thickness as upon a board machine. In any event it will be desirable to coat the primary web with additional dispersed rubber so as to increase the percentage of rubber in the complex. To avoid loss of rubber in subsequent pressing, drying may manifestly be introduced anywhere as an intermediate step in the co-ordinated series of operations.

The material thus obtained can be used directly as a substitute for the sheet of cords covered with frictionated rubber which commences the building up operation of the finished rubber-fiber structure. In common with such material it will be very rigid in the direction of the fibers and more elastic in the transverse direction. As in the case of the corded fabric this discrepancy between the effect of longitudinal and transverse stress will be compensated for in the final structure by crossing the sheets on the bias at the will of the operator.

The strength of such a sheet depends in the first instance upon the strength of the individual fiber and the high strength of best fibers can thus be utilized to the full as in this case the bad effects of torsion are manifestly non-existent. Actual cohesion between the fiber and the rubber is also of great importance and can be much enhanced if the fiber be treated with a sulphide dyestuff capable of forming an actual chemical combination with the fiber and with the rubber as well in the final vulcanization. The natural dark color of sulphide cooked fiber is due to such a combination and hence fiber should not be bleached.

I am aware of the fact that the use of a dispersed form of rubber, to wit, latex has been in use for many years as a form of paper making, the product being in general some type of "artificial leather." I am also aware of the fact that the soaking of a sheet of paper in latex after its formation has been used and that such a sheet has been rendered more absorbent for latex by a preliminary mercerization of the fiber, but all such devices are manifestly modifications of paper making while the process herein disclosed is the very reverse of paper making.

While the process herein described has so far concerned itself with the use of bast fiber, it can manifestly be used on the customary short types of paper pulp although not with the resultant strength in the finished product. I also wish to define the meaning of the words "dispersed rubber" in the sense in which it is used herein. It may be considered as a generic term in which are included the natural latex from the tree, the artificially dispersed material made from solid rubber by a combination of chemical and mechanical method and finally it is also meant to include the highest form of dispersion, namely, solution in organic solvents and the like.

Instead of treating the primary web in the manner so far indicated it may be split into very narrow ribbons and these may then be twisted to any extent desired. Such ribbons thus partake of the nature of yarn, but due to the adhesive effect of the additive rubber such twisting can be at the same time moderate and yet effective. Yarn thus produced can then manifestly be again combined into cords and throughout the sequence of operations the sheet itself, the yarn, and the cord can be coated with dispersed rubber to any extent desired.

It will be manifest that in this manner the percentage of rubber in the final article can be controlled at will and the final cords can then be used in the rubber structure in much the same manner as the composite cord-rubber sheet which is the foundation for most of the built up rubber goods.

As already mentioned in the making of the primary web, I regard any additions to the dispersed rubber before it is used of such substances as pigments, fillers, and vulcanizing agents with their accelerators as a definite part of my process which is entirely at the discretion of the operator in accordance with the specific demands of the special article under preparation and hence cannot be specified more closely herein.

The term "bast fiber" used in the text so far as well as in the claims also require definition. It is evident that seed hairs from cotton and pulp made from the trunk of a tree could not possibly be classed as "bast fibers" but on the other hand the fiber released on cooking pineapple leaves is as much a bast fiber as that from jute, ramie, and flax, as well as hemp. The same applies to some of the straw fibers, notably rice, and as this is of interest to the rubber manufacturer because of the exceeding fineness of the fiber I also wish to include this particular type of straw fiber under the above mentioned generic appellation.

Having thus clearly explained the salient points and advantages of my process and clearly set forth the distinction between it and existing practice, I claim:

1. The method of commingling rubber and unbeaten, unbleached fiber which comprises; forming said fibers in a state of parallelism into

a sheet upon a moving wire; arranging the fibers in said state of approximate parallelism by causing a water suspension of said fiber to travel in a smooth flow substantially free from transverse currents before it reaches the wire and during the preliminary stages of dehydration upon said wire; coating the web thus produced with dispersed rubber; and superimposing as many such layers, one upon another, as may be required to produce a sheet of the required thickness.

2. A claim similar to claim 1, with the added step that dispersed rubber be added to the suspension of fiber in water thus producing a more manageable sheet for the coating operation.

3. A claim similar to claim 1, with the added step that the sheet produced in the initial operation be dried before it be coated with dispersed rubber in the subsequent stage.

4. The method of introducing bast fibers in an unbeaten and unbleached condition into a rubber complex which comprises; liberating the fiber

from its original locus in the plant by digestion with an alkaline sulphide; washing and shortening the fiber to an approximate length averaging $\frac{1}{2}$ inch or less; forming the fibers thus prepared in a state of parallelism into a sheet upon a moving wire; arranging said fibers in a state of approximate parallelism by causing a water suspension of said fiber, in its original unbleached condition, to travel in a smooth flow substantially free from transverse currents before it reaches the wire and during the preliminary stages of dehydration upon said wire; impregnating the web thus produced by coating with dispersed rubber; and finally building up this primary web into structural rubber forms.

5. A claim similar to claim 4, with the added step that dispersed rubber be also added to the water-fiber suspension before it be admitted to the wire.

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