

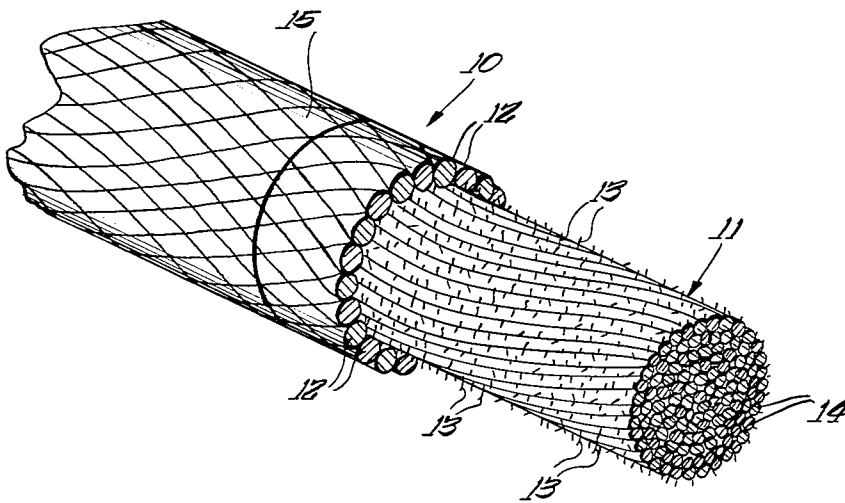
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LINE AND METHOD OF MANUFACTURE THEREOF

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LINE AND METHOD OF MANUFACTURE
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The present invention relates to lines or strings of the type used in tennis, badminton and squash racquets. Such lines are usually made of synthetic plastic materials such as nylon and purified animal fibers commonly known as "gut." When used in these lines, the synthetic plastic is desirable for its qualities of long wear and resistance to abrasion. The animal fiber is desirable due to its greater resilience and higher resistance to tensile forces than the synthetic plastic.

The primary object of the present invention is to provide a novel line having the desirable characteristics of both animal fiber lines and synthetic plastic lines.

Another object is to provide a line with improved resilient and wear qualities by utilizing a central core of animal fibers and a protective cover of synthetic plastic.

A more detailed object is to interlock the animal fiber core and the synthetic plastic cover in a novel manner preventing shifting of the cover along the line relative to the core.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawing which is a fragmentary perspective view of a line embodying the novel features of the present invention, some of the parts being broken away.

The line or string 10 shown in the drawing to illustrate the present invention is especially adapted for use in racquets for games like tennis and badminton where it is desirable to have a taut line which also is resilient. A material possessing the desired resilience and capable of withstanding tension sufficient to produce the desired tautness is collagen, an animal fiber which is called "gut" and is purified before its formation into lines. To prolong the service life of a line in a racquet, the line should be impervious to moisture and harmful liquids such as acids and alkalis and be capable of resisting abrasion. These desirable characteristics have been found to exist in synthetic plastic materials such as those of the amido-polymer type; for example, nylon.

In accordance with the present invention, the line 10 is constructed in a novel manner to combine the desirable characteristics of both the animal fibers and the synthetic plastic material. This is accomplished by utilizing animal fiber in a central core 11 and enclosing the same in a cover or sheath 12 of the synthetic plastic which is mechanically locked to the core. To effect such locking, the core includes a plurality of individual fibers 13 of synthetic material which themselves are locked mechanically to the animal fiber and integrally to the sheath.

The animal fiber in the core 11 is in the form of elongated strands or ribbons 14 which are twisted together while moist and are allowed to dry while they are maintained in the twisted condition and under tension in a manner well known in the art. To achieve the mechanical interlocking of the synthetic fibers 13 with

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the animal fiber strands, the synthetic fibers are interposed between the strands before the twisting operation. To this end, the animal strands in a moistened condition are laid flat and side by side on a horizontal supporting surface (not shown) and the synthetic fibers are sprinkled on the exposed portions of the strands. The strands being tacky when in a moistened condition, the synthetic fibers tend to stick to and be carried with the strands as they are stretched and twisted into the core. During the stretching and twisting operations, the synthetic fibers become wrapped around and between the strands, or interwoven therewith, so that, when the core is dry, the fibers are interspersed throughout the core and some portions of the fibers are interlocked mechanically with the strands beneath the surface of the core while other portions are exposed and project from the core.

The number of animal fiber strands 14 used in the core 11 depends on the width of the strands and the desired diameter of the core, the number varying, for example, from sixteen to twenty-six strands in some instances. The synthetic plastic fibers 13 are much smaller than the animal strands, a size of .001 to .005 of an inch in diameter and $\frac{1}{16}$ to $\frac{1}{8}$ of an inch in length having been found to be satisfactory. These are sometimes called short staple fibers.

Preferably, the cover 12 is formed of a plurality of strands of the synthetic plastic material braided together about the core 11. These strands are banded integrally to the synthetic fibers 13 in the core and, through the latter, are locked mechanically to the strands 14 of animal fiber. Such integral banding is effected by treating the cover and the synthetic fibers with a solution of synthetic material which hardens to lock the parts together, this solution and the cover being of the same synthetic material as the core fibers in this instance. While the solution may be applied during the braiding operation, it is preferred to apply the solution as an exterior coating 15 which not only penetrates the cover to become bonded to the core fibers, but also, fills the voids between the cover strands so as to provide a smooth exterior for the line 10. The cover strands preferably are of the monofilament type so as to avoid fraying. One braid found to be satisfactory was formed of eight strands. One way of applying the synthetic solution as a coating is to dip the covered core in a bath of the solution and remove the excess by wiping as the line leaves the bath.

It will be apparent that the improved line 10 will have the desired characteristics of an animal fiber line by virtue of the strands 14 of this material in the core 11. Yet, the disadvantages of the material are avoided and a more wear-abrasive and liquid-impervious line is provided by the synthetic plastic cover 12. The combination of these materials which do not tend to adhere to each other is achieved by a mechanical interlocking of the synthetic fibers 13 with the animal fiber strands 14 in the core. Not only does the interlock between the cover and the core prevent shifting of the two longitudinally of the line, but it also prevents untwisting of the core strands so as to prolong the life of the core. This is especially important during stringing of the line in a racquet where the line is woven back and forth.

I claim as my invention:

1. The method of manufacturing a line comprising the steps of, covering elongated ribbons of purified animal fiber in a moistened condition with a plurality of individual fibers of a synthetic plastic material, twisting the covered ribbons together and drying the same under tension to produce a core with the synthetic fibers mechanically locked between and projecting from the rib-

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bons, braiding strands of synthetic plastic material about said core to form a sheath, and treating the sheath and the synthetic plastic fibers in said core with a synthetic plastic solution to bond such fibers and sheath integrally together and thereby lock the sheath mechanically to said animal fiber.

2. The method of manufacturing a line comprising the steps of covering elongated ribbons of purified animal fiber with a plurality of individual fibers of a synthetic plastic material, twisting the covered ribbons together to produce a core with the synthetic fibers mechanically locked between and projecting from the ribbons, braiding strands of synthetic plastic material about said core to form a sheath, and treating the sheath and the synthetic plastic fibers in said core with a synthetic plastic solution to bond such fibers and sheath integrally together and thereby lock the sheath mechanically to said animal fiber.

3. The method of manufacturing a line comprising the steps of, forming a core of twisted ribbons of purified animal fiber with a plurality of fibers of synthetic material mechanically locked between and projecting outwardly from the ribbons, braiding strands of synthetic plastic material about said core to form a sheath, and treating the sheath and the synthetic plastic fibers in said core with a synthetic plastic solution to bond said fibers and sheath integrally together and thereby mechanically to said animal fiber.

4. The method of manufacturing a line comprising the steps of, forming a core of twisted ribbons of purified animal fiber with a plurality of fibers of synthetic material mechanically locked between and projecting outwardly from the ribbons, braiding strands of synthetic plastic material about said core to form a sheath,

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and bonding said sheath and said synthetic fibers integrally together and thereby locking the sheath mechanically to said animal fiber.

5. A line comprising a core of twisted ribbons of purified animal fiber, a plurality of synthetic plastic fibers mechanically locked between the ribbons, a sheath of synthetic plastic strands braided about said core, and a coating of synthetic plastic material penetrating through the sheath to lock the sheath integrally to said synthetic fibers and mechanically to said ribbons.

6. A line comprising a core of twisted ribbons of animal fiber, a plurality of synthetic plastic fibers mechanically locked between the ribbons, and a sheath of synthetic plastic strands braided about said core and bonded to said synthetic fibers so as to be locked mechanically to said animal fiber.

7. A line comprising a core of twisted ribbons of animal fiber, a plurality of synthetic fibers disposed between and mechanically locked with said ribbons, and a sheath of synthetic plastic material bonded to said synthetic fibers so as to be interlocked mechanically with said ribbons to prevent shifting of the sheath relative to the core along the line.

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