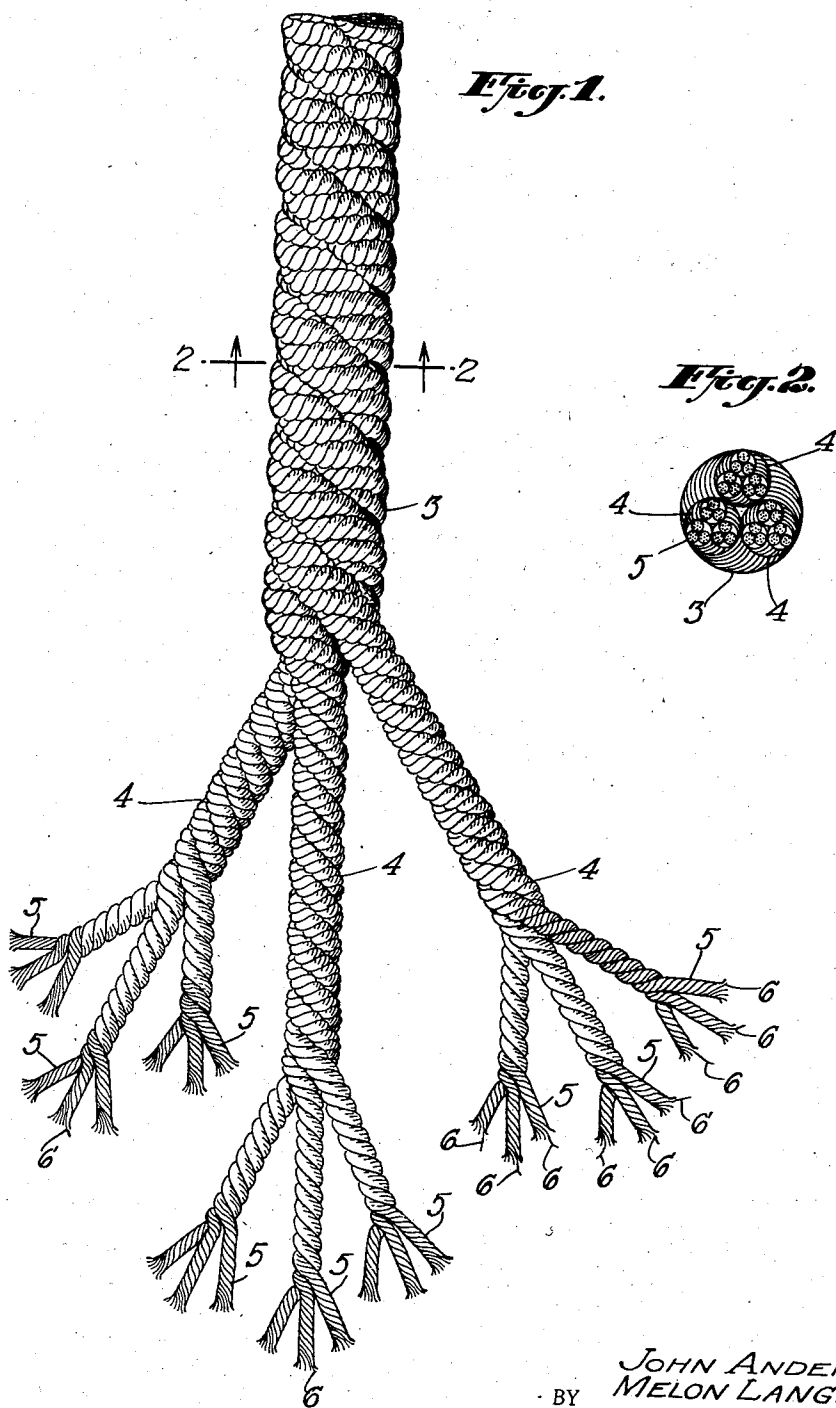


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CORD AND ARTICLE MADE OF CORD
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CORD AND ARTICLE MADE OF CORD

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Our invention relates to improvements in cord, that is, filamentary articles made by twisting fibers together, and also to methods of making cord. The invention also comprises improvements in articles or materials made from or incorporating cord as, for example, the building of pneumatic tires.

In the making of cord of the type to which our present invention relates "single" yarn or "singles" is made by a spinning operation in which the carded fibers are twisted to form the elementary or starting filaments. A number of singles thus formed are then twisted together, forming strands, which strands may then be twisted or combined with other strands to form cords or larger strands which may thereafter be further combined in case cords of larger dimensions are required.

In cords heretofore made it has been customary to reverse the twists given in each successive stage of the building of the cord. The amount of twisting given to each cord and which is termed "contributory twisting" is the amount of twisting done on the cord in the various twisting operations, irrespective of the direction of twist. The amount of twist present in the cord after the final twisting operation is completed is known as "total twist".

In contradistinction to prior cords and methods of making the same, our present invention provides a cord in which three or more twisting operations of the cord are all in one direction, that is, in which, for example, the spinning of the singles, the twisting of the singles into a strand and the twisting of the strands into a cord are all accomplished with a uni-directional twist, there being at least three such twisting operations in one direction. These three twisting operations may be consecutive, they may start with the spinning, or they may finish with the final three twisting operations, or they may comprise any combination of the original and final twisting operations. Inasmuch as cords composed of elements all of which have been twisted in one direction have less resistance to untwisting, the twists in the various elements of the cord are subjected to a setting treatment to hold them in their twisted positions and to prevent or resist the untwisting of the strands or cord elements. The cord may also be given a stretch, either upon completion or during the building of the cord so that the finished cord will have less residual stretch.

In our invention less contributory twisting is required to achieve a given strength or expansibility, or both, than in prior methods using reverse twists, inasmuch as each of the three or more twisting operations contributes to the total twist without negating any of the twisting

previously imparted or imparted by the formation of previous elements.

In a typical embodiment of our invention, for example, single yarns are made by twisting carded fibers in a given direction. Five such single yarns made of twisted fibers are then twisted together to form a five-fold yarn. Three such five-fold yarns are then twisted together in the same direction to form a fifteen-fold tire cord. In this method there are, therefore, three twisting operations, the first being the spinning of the fibers into single yarn, second the doubling of the single yarn to make the composite yarn and third, the cabling of the composite yarn to make the final cord. In this method it is evident that inasmuch as the twist is in the same direction for all three operations, the act of inserting a twist in each operation as, for example, in the last operation or twist, will contribute to the twist already present from the preceding operation or twist as, for example, in the first two operations or twists. Accordingly, less twisting than that finally required can be inserted in the first two twists or operations. The uni-directional twisting as in our invention, therefore, avoids an over-plus of twisting such as has heretofore been necessary. This not only reduces manufacturing costs, but also improves the quality of the cord inasmuch as it reduces energy loss and increases the resistance to fatigue.

The following is an example of the twisting operation of a cord formed according to our invention and a corresponding cord formed by the conventional methods heretofore used:

Twisting operation	Conventional cord, twist per inch	Improved cord, twist per inch
Spinning.....	15.5	13.5
Doubling.....	20.5	8.5
Cabling.....	9.5	8.5

Both these cords are of 3/3/13.7 construction, that is, nine singles each of 13.7 count are twisted together in groups of three, and three such groups are twisted together to form the cord; in the conventional cord, cabling is in a direction opposite to that of spinning and doubling, while in the improved cord all three operations are in the same direction.

In the example it will be seen that the improved cord involves much less contributory twist than the conventional cord but, nevertheless, the strength and extensibility, which depend upon the total twist, are substantially the same in both cases.

It should be noted that the total twist cannot be calculated simply by giving a positive sign to the twist in one direction and a negative sign to

the twist in the other direction and taking the algebraic sum—the matter is complicated by changes in length of yarn with changes in twist.

To resist the tendency for uni-directional cord 5 to untwist, the cord is set by a suitable setting treatment applied either during or subsequently to the production of the cord. This setting treatment may be combined with treatments of the cord for other purposes. For example, it may 10 comprise the treatment with adhesives which may form an element of an article for which the cord is used. In cord fabrics for tires, for example, the cords are coated in web formation with a plastic rubber mixture. We may utilize 15 this rubberizing as a setting treatment in our process or, for example, the setting may be effected by soaking the cords in a liquid rubber mixture, or other suitable agent, such as gum arabic. Another method of setting the cords may 20 be accomplished by steaming under sub-atmospheric pressure or otherwise. This has the effect of setting the cord sufficiently to enable it to be readily handled during the operations to which it may be subsequently submitted.

To produce a low stretch cord, that is, one which does not stretch very much in use, the cord may be subjected to a stretching treatment applied either before or after setting.

A cord embodying the invention is shown by way of example in the accompanying drawing, in which—

Fig. 1 is a length of cord having one end frayed out to show the different elements of the cord and their direction of twisting.

Fig. 2 is a cross section taken on the line 2—2 of Fig. 1.

In this embodiment of the invention the cord 3 is made up of a braid of combinations 4 of strands 5, each of which is in turn formed of fibers 6. In the embodiment shown, the cord is made up of three separate combinations, but it will be understood that any desired number may be employed. Similarly, each combination is shown as made up of three strands, but it will be understood that this is only by way of illustration and that any number of strands may be combined in each combination. In each of the strands 5 the individual fibers 6 are twisted in a right handed or clockwise direction. Each of the strands 5 50 thus formed is in turn twisted in a clockwise direction to form the combination 4. The combinations of strands are then twisted again in a clockwise or right handed direction, forming the finished cord 3. It will be understood, however, 55 that a left handed or counter-clockwise twisting may be employed provided it is employed throughout, that is, for the fibers 6, strands 5 and the combinations of strands 4.

What we claim is:—

60 1. A cord formed of single yarns of fibers twisted in one direction, a plurality of said single yarns being combined and twisted in the same direction as the twist of said single yarns to form strands, and a plurality of said strands being 65 twisted together to form the cord, the direction of said final twist being the same as that of said single yarns and of said strands.

2. A cord formed of single yarns of fibers 70 twisted in one direction, a plurality of said single yarns being combined and twisted in the same direction as the twist of said single yarns to form strands, a plurality of said strands being twisted together to form the cord, the direction of said

final twist being the same as that of said single yarns and of said strands, and the twists in said several elements being set to resist the untwisting thereof.

3. A cord formed of single yarns of fibers 5 twisted in one direction, a plurality of said single yarns being combined and twisted in the same direction as the twist of said single yarns to form strands, and a plurality of said strands being twisted together to form the cord, the direction 10 of said final twist being the same as that of said single yarns and of said strands, the twists of said elements being set by rubber composition incorporated therein to resist the untwisting thereof.

4. A cord formed of single yarns of fibers 15 twisted in one direction, a plurality of said single yarns being combined and twisted in the same direction as the twist of said single yarns to form strands, and a plurality of said strands being twisted together to form the cord, the direction of 20 said final twist being the same as that of said single yarns and of said strands, the various elements of said cord being set by steaming to resist the untwisting thereof.

5. A cord fabric for tires comprising cords, each 25 of said cords in turn comprising single cords made by twisting fibers in one direction, double strands formed by twisting a plurality of said singles in the same direction as the twist imparted to said singles and having several of said double elements 30 twisted together in the same direction as the twist of said singles and double elements.

6. A method of making cords which comprises forming cord elements by twisting fibrous materials to form singles, combining several of said 35 singles in a twisting operation in the same direction of twist as that of said singles, and combining the elements thus formed by twisting in the same direction of twist as said singles to form a cord.

7. A process of forming a cord which comprises twisting cord forming material into elements, twisting a number of elements thus formed into combinations, and successively twisting the combinations thus formed into successively larger 45 combinations, there being a total of at least three twistings, all of said twisting operations being accomplished with the same direction of twist.

8. The method of claim 7 in which the uni-directional twisting operations comprise the final 50 three operations.

9. A process of forming cord which comprises twisting cord forming material into elements, twisting a number of elements thus formed into combinations, and successively twisting the combinations thus formed into successively larger combinations, there being a total of at least three twistings, all of said twisting operations being accomplished with the same direction of twist, and setting the twists of said cord. 60

10. The process of claim 9 in which said setting is accomplished by steaming.

11. The process of claim 9 in which said setting is accomplished by an adhesive agent.

12. The process of claim 9 in which said setting 65 is accomplished by incorporating in said cord a rubber composition.

13. The process of claim 9 in which said cords are subjected to a stretching operation before being formed into the fabric. 70

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