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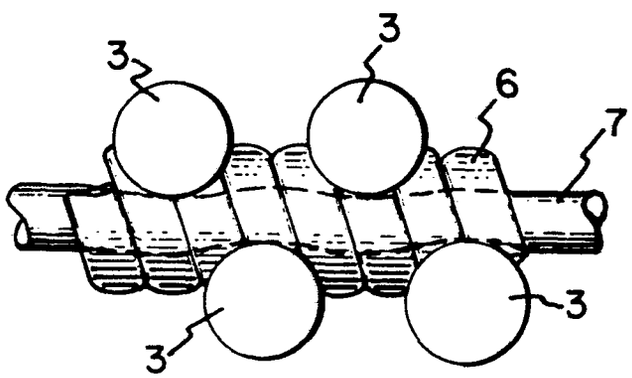
(54) **Fill yarn, method of manufacture and uses thereof.**

(57) A fill yarn, (2,) with a deformable surface is used in forming the tabby portion, (4,) at the ends of rolls of tire fabric. Such usage results in reduced curtaining, webbing, splitting, and wrinkling of the fabric in areas adjacent to the tabby portion. This, in turn, results in less scrap fabric.



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FILL YARN, METHOD OF MANUFACTURE AND USES THEREOF

The foregoing abstract is not to be taken as limiting the invention of this application, and in order to understand the full nature and extent of the technical disclosure of this application, reference must be made to the accompanying drawings and the following detailed description.

Background of the Invention

The present invention relates to a new type of fill yarn, its method of manufacture, uses thereof, and methods of using said fill yarn, in particular its uses in the tabby portion of tire cord fabric.

Fabric used in the reinforcing of tires is normally comprised of the tire cords placed in the warp or longitudinal direction of the fabric and being woven or held by a relatively weak fill yarn placed perpendicular to the cords. The number of cords per inch in tire cord fabrics normally varies between 15 and 25 depending on the end uses. The number of fill yarn per inch varies between 1/2 to 2.

The tire cord could be made from any one of the typical polymeric reinforcing materials such as polyester, nylon, aramid, fiberglass, rayon, polyvinyl alcohol, etc. The fill yarn normally is made from staple fiber such as polyester, cotton, rayon, nylon, etc. or blends thereof. The fill yarnsdo not contribute to the reinforcement of tires and its purpose ceases once the fabric is calendered or sandwiched between uncured rubber stock. The main purpose of the fill yarn is to maintain the structural integrity of the fabric during treatment. It is a common practice to treat fabric used in reinforcing tires by dipping the fabric in a liquid medium such as a latex. This treatment is to improve the adhesion between the fabric and the rubber matrix of the tire. The untreated fabric is normally wound into a roll. As the last piece

of fabric leaves the roll and before it enters the dip unit, it is common practice to attach the tail end of the untreated roll being treated with the first end of the next roll to be treated. When the ends of the rolls are tied together, whether by sewing, use of an adhesive, or any other method, it is normally necessary to increase the concentration of the fill yarn at the end of the roll. This section of the fabric is known as the tabby and normally measures in length between 5 and 20 inches.

The high concentration of the fill yarn at the tabby contributes to the strength of the splice or seam. The splice must withstand the high tensions encountered during the treatment of the fabric at the dip unit and calender. The tabby is not used in reinforcing tires and is discarded at some point of the operation. Normally, several yards of the treated tire cord fabric adjacent to the tabby are also discarded as waste. The tabby splice being narrower than the roll's width, contributes to tire cord fabric scrap which begins from the tabby and extends on both sides of the splice into the tire cord fabric sections by several yards. The amount of scrap can vary between 10 and 30 yards depending on the tire cord fabric construction and the treatment.

Because of the closeness of the fill yarn to one another in the tabby section of the fabric, there is an increased crimping of the fill yarn by the warp cord, which is held under tension during the weaving. This leads to a narrowing of the fabric width to accommodate the new fill yarn configuration; i.e. from a relatively straight configuration to a wavy or crimped configuration. The tabby being narrower than the fabric contributes to the "curtaining" effect when two rolls are spliced together at their tabbies. The curtaining effect results in a wrinkling of the fabric. Similarly, during dipping, the high warp tension further crimps the fill yarn and

the difference between the width of the tabby and the rest of the roll, and therefore the curtaining effect and wrinkling can be increased even further on up the roll.

This curtaining effect results in tire cord fabric scrap. Some of the typical defects resulting in the scrapping of fabric are: (1) different dip penetration; (2) webbing streaks (layer of adhesive film connecting the adjacent tire cords in the fabric); (3) fabric splitting lengthwise and caused by the spreaders of the machine in an attempt to bring the splice width equal to fabric width, and (4) crushed cords occurring at the dip roll of the calender due to the wavy and folding condition of the section of the fabric found near the tabby. It has long been desired to reduce this curtaining effect and therefore the amount of scrap fabric resulting therefrom. The present invention helps to alleviate the effects of some of the aforementioned problems by the use of a fill yarn having a readily deformable surface. The fill yarn, although not limited thereto, can be comprised of a core comprised of one or more yarns, including monofilaments, but preferably one yarn surrounded by a sheath having a deformable nature. By "deformable" is meant a surface which when subjected to the stresses and strains normally encountered by a fill yarn during tensioning of a tire cord fabric either prior to or during dipping, or at any other point in the processing of the tire cord fabric, will deform to accommodate the movement of the warp cord as a result of placing tension on said cord.

Brief Description of the Drawings

Figures 1B and 3 depict prior art tire fabric constructions;

Figures 1A, 2, 4 and 5 depict embodiments of the present invention;

Figures 6A, 6B, 6C and 6D depict methods of preparing the fill yarn of the present invention.

Detailed Description of the Invention

In Figure 1A, there is illustrated a view of tire cord fabric 1 showing the warp cord 3 and fill yarn 2 of the present invention and the tabby portion 4 at the end of the fabric where the fill yarn 2 is more highly concentrated. It should be noted that conventional fill yarn used in the body of the fabric is normally lighter than the fill yarn used in the tabby portion of the fabric.

Figure 1B illustrates the narrowing down of the fabric in the tabby area 4 when the fabric contains prior art fill yarn 2. The narrowing down can result in a curtaining effect, wrinkling in the area of the fabric adjacent to the tabby area, as well as webbing due to dip pick-up, and splitting thereby necessitating scrapping of the affected body fabric.

Figure 2 is a section taken on the line 2-2 of Figure 1A. It illustrates the warp cord 3 and fill yarn 2 arrangement of the present invention. With fabric containing conventional fill yarn 3 in the tabby area 4, the fill yarn 3 crimps as illustrated in Figure 3 and the tabby width is narrower than the body fabric as illustrated in Figure 1B.

Figure 4 illustrates a cross-section of a fill yarn 8 of the present invention with a core 7 and a deformable sheath 6.

Figure 5 offers a more detailed view of Figure 2 using a fill yarn 8 of the present invention where the sheath 6 is a yarn wrapped around the core 7. It is believed the sheath deforms, as illustrated in Figure 5, resulting in crimp reduction.

This sheath can be comprised of any material which will deform under the stresses and strains mentioned earlier herein. Naturally, the sheath should not be of a composition which would interfere with the characteristics of warp cord which are required to permit the cord to operate effectively in a tire. For example, it should not interfere with the adhesion of the cord to the surrounding rubber matrix in a tire.

The sheath can be comprised, but is not limited to, foam rubber. It can also be comprised, but is not limited to, filaments or strands spirally wrapped around the core. The filaments or strands can be wrapped around the core one strand or filament at a time or several strands or filaments can be wrapped around the core simultaneously. From a practical manufacturing and processing standpoint, it is preferred that several strands be wrapped around the core simultaneously, for example, five to ten strands at a time. More than one layer of cords can be used.

Whereas the sheath is a soft and deformable material, the core is flexible, strong, extensible material which can consist of one or more yarns. In other words, the core characteristics are merely those industrial strength characteristics possessed by conventional fill yarns. In fact, most if not all conventional fill yarns can be converted to fill yarns of the present invention by applying to them a sheath such as described herein.

The method by which the outer sheath is applied to the core is not significant so long as the sheath retains its soft, deformable characteristics and the core remains flexible, strong, and extensible.

The purpose of conventional fill yarns is to hold the warp cords in position and prevent them from moving up and down or from side to side. It is believed that this is accomplished by the friction at the interface of the fill yarn and the warp cord. Unfortunately, in the use of conventional fill yarn, this also results when the warp cord is placed under tension in a curving of the fill yarn and therefore a shortening of the fabric width. In the present invention, it is believed that the soft, deformable sheath surrounding the cord of the fill yarn deforms when the warp cord is placed under tension, maintaining the friction between the warp cord and the fill yarn, and in fact partially surrounding the warp cord

to prevent its movement, thereby reducing the change in the shape of the core, and thereby permitting the fill yarn to retain a large portion of its original length even when the warp cord is placed under tension.

In selecting the material to be used for the core and the sheath, one need only follow the guidelines above. Twist, cord count, whether the material is synthetic or natural, and if synthetic, what synthetic is used, whether mono and multifilament is used and whether a staple or continuous fiber is used, are not critical per se. That is, these factors are only important when they affect the properties described above for the core and the sheath. For example, if too great a twist results in a sheath that is so hard as to not be deformable, it should be avoided.

It is not necessary for the fill yarn of the present invention to reduce the tabby shrinkage entirely. Rather, it is sufficient if the shrinkage due to mechanical stress is just measurably reduced over conventional fill yarns used for the tabby portions of fabric, for example, over the shrinkage obtained using the core alone as the fill yarn.

Various materials can be used for the core and sheath including, but not limited to, polymeric materials, such as nylon, rayon, polyester, cotton and aramid yarns, or blends thereof.

Figures 6A, 6B, 6C, and 6D illustrate but do not limit methods by which fill yarn of the present invention can be prepared.

Figure 6A illustrates a ring-twister 12 with one set of feed rolls 11. When twisting together yarns of different count, the yarn with the higher count will normally wrap around the heavy yarn. Thus, 7 ends of 13's (16-Z turns per inch) 9 and one end of 4's (9-Z turns per inch 10 are twisted together into a 9-S turn per inch with the 4's yarn 10 being completely wrapped with the 13's yarn 9 to form the fill yarn 12.

Figure 6B illustrates a ring twister 13 with two sets of feed rolls 11 and 14. By this method the 4's yarn 10 is fed at a slower rate than the 13's yarns 9 resulting in a better defined fill yarn 12 construction than is normally obtained by the process illustrated in Figure 6A.

Figure 6C illustrates the use of a yarn cover machine 15 which results in a preferred fill yarn 12 structure.

Figure 6D illustrates the coating of a yarn 10 with a polymer 17 using an extruder 16 to form a fill yarn 12 of the present invention.

A nylon tire fabric with a body width of 60 inches had a tabby width of 56 inches when using a conventional tabby fill yarn. When using a tabby fill yarn with a 2 x 13's polyester/cotton blend core and a 7 x 13's polyester/cotton blend sheath, the tabby width was 59.5 inches. After a dipping process, the body width was reduced to 54 inches. The tabby with the conventional fill yarn had a width of 48 inches, while the tabby with the fill yarn of the present invention had a width of 53 inches.

The fill yarn of the present invention can be used in the body of the fabric, as well as the tabby portion. Where the body of fabric is subject to severe thermal shrinkage conditions and mechanical tensioning such that the combination of factors results in unreasonable width reduction in the body of the fabric, the use of the fill yarn of the present invention in the body of the fabric is beneficial.

While certain representative embodiments and details have been shown for the purpose of illustrating the invention, it will be apparent to those skilled in this art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

WHAT IS CLAIMED IS:

1. A fill yarn characterized by a readily deformable surface.

2. The fill yarn according to Claim 1 characterized by a core and a deformable sheath surrounding said core.

3. The fill yarn according to Claim 2, characterized wherein the core is a yarn and the sheath is a yarn wrapped around said core.

4. The fill yarn according to Claim 3, characterized wherein the core is a staple yarn and the sheath is a staple yarn.

5. The fill yarn according to Claim 4, characterized wherein the core yarn is a heavier yarn than the sheath yarn and the sheath yarn has a higher count than the core yarn.

6. The fill yarn according to Claim 2 characterized wherein the sheath is comprised of a polymer coating.

7. The fill yarn according to Claim 6, characterized wherein the polymer coating is foamed rubber.

8. Tire cord fabric, characterized wherein the tabby end of which contains fill yarn according to Claim 1.

9. A method of reducing tabby shrinkage in tire cord fabric characterized by fabricating the tabby portion of said tire cord fabric with the fill yarn of Claim 1.

10. A method of producing a fill yarn, characterized wherein a sheath yarn is spirally wrapped around a core yarn.

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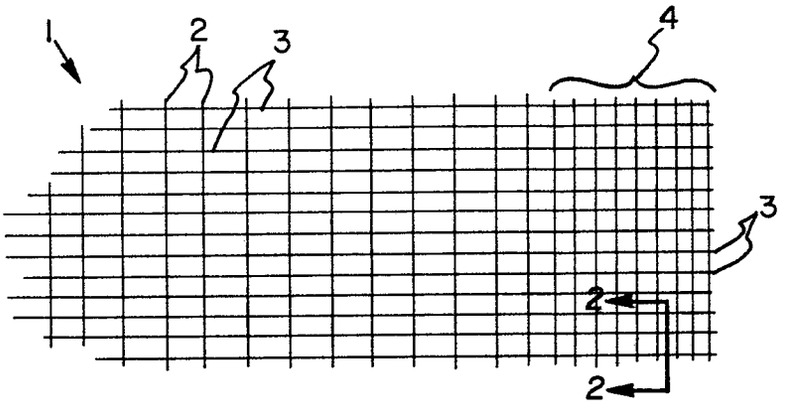
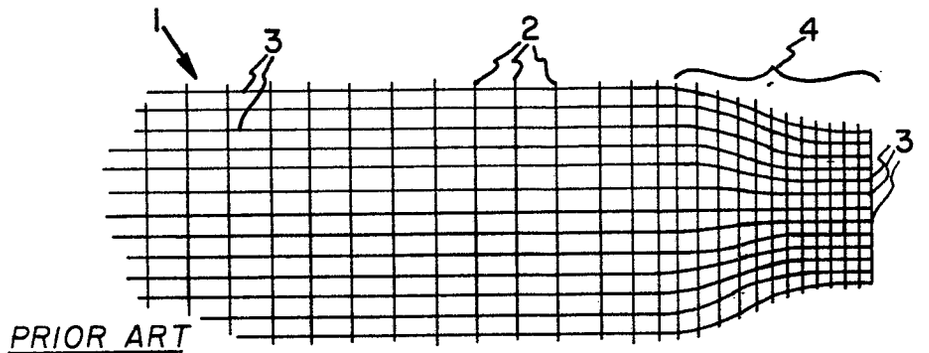


FIG. 1A



PRIOR ART

FIG. 1B

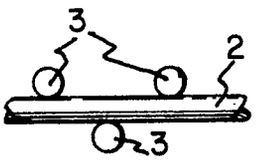


FIG. 2

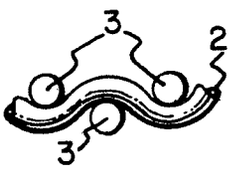


FIG. 3

PRIOR ART

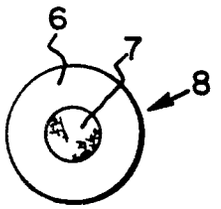


FIG. 4

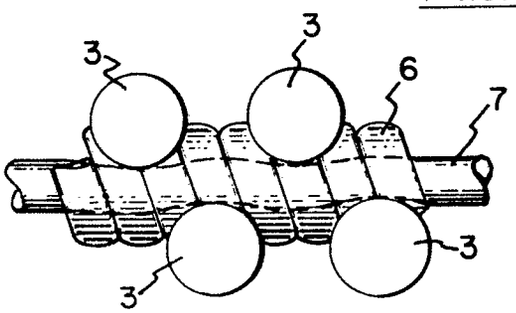


FIG. 5

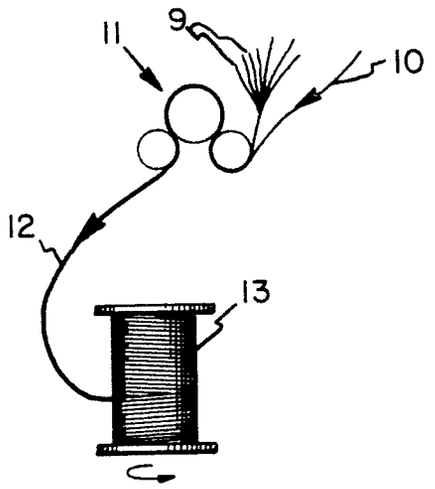


FIG. 6A

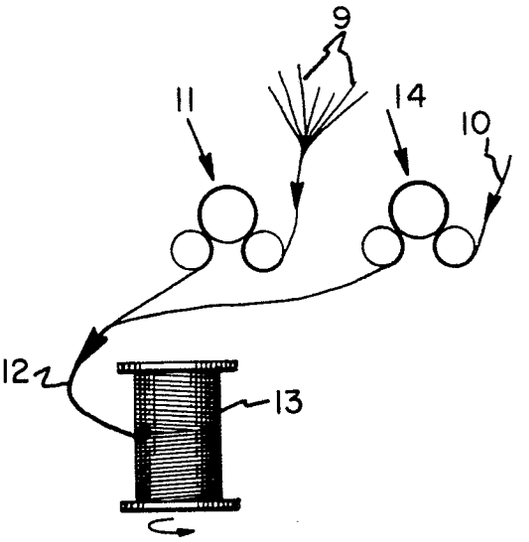


FIG. 6B

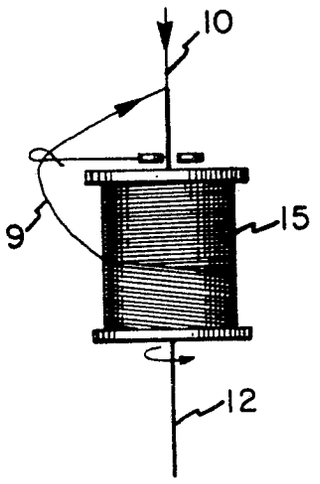


FIG. 6C

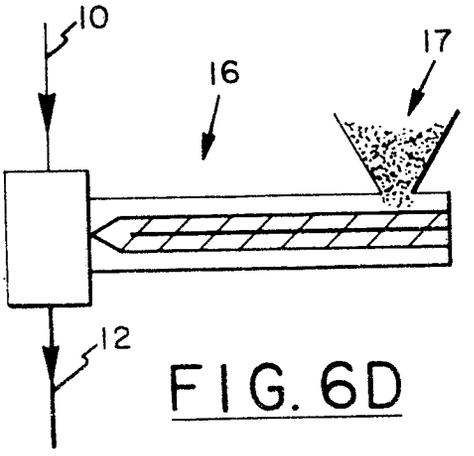


FIG. 6D