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LAMINATED FABRICS

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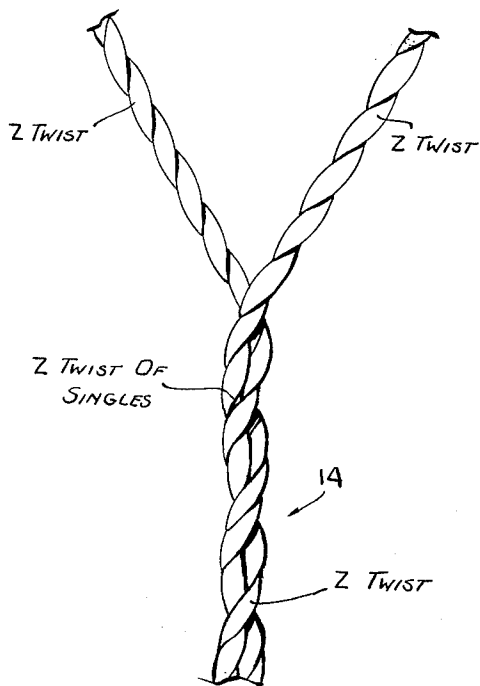
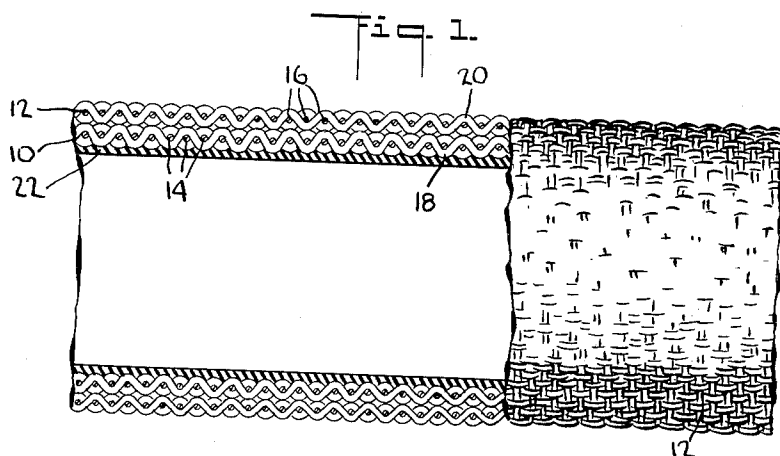


Fig. 2.

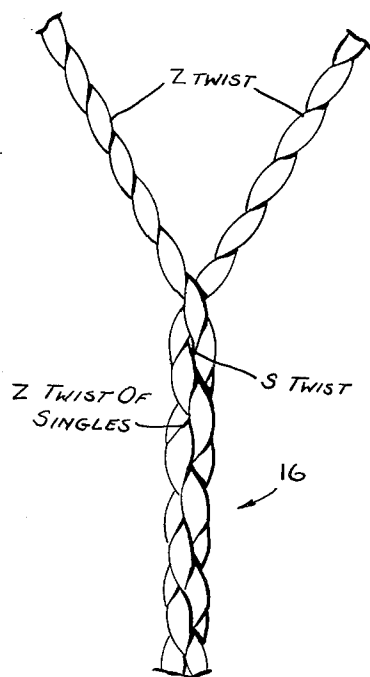


Fig. 3.

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LAMINATED FABRICS

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The invention relates to laminated fabrics, and is more particularly directed to improvements in multilayered hose.

In hose of the type comprising inner and outer circular woven jackets reinforced with rubber or rubber-like material, the filler yarns of the jackets form substantially concentric rings. In order that each of the filler yarns may absorb the maximum of its stress capacity before rupture when the hose is subjected to internal hydrostatic pressure, the filler of the inner jacket should have a higher ultimate or breaking elongation than the filler of the outer jacket. This difference in breaking elongation should allow for a normal fit between the inner and outer jackets, and permit the proper and slight expansion of the inner jacket before the outer jacket is placed under stress. Also, the greater elongation of the inner jacket filler should compensate for the slightly longer path of the filler yarn in the outer jacket, the longer path being due to the larger diameter of the outer jacket.

In the double jacketed hose woven entirely of cotton as presently manufactured, the filler yarns in the inner and outer jackets have substantially the same extensibility or breaking elongation. It has been proposed to provide a filler yarn of polyester filaments in the inner jacket and a filler of cotton in the outer jacket, cotton warps being provided in both the inner and outer jackets. While the filler yarn of polyester filaments of the inner jacket provides a higher elongation than the cotton outer jacket filler, the use of these dissimilar fibers presents manufacturing difficulties and introduces certain limitations of the product, as well as increasing the cost of manufacture. The breaking elongation of polyester filament yarn greatly exceeds that of cotton yarn, so that it is difficult to realize the maximum stress capacity of both the inner and outer jackets. Too great a difference in the breaking elongation of the inner and outer filler yarns requires a loose fit between the jackets, which must be closely and carefully controlled, and presents manufacturing difficulties.

While an increase in elongation before rupture of the filler yarn in the inner jacket may be obtained by twisting the yarn to a higher level of twist, as compared to the twist of the filler yarn in the outer jacket, such increase in twist results in a substantial loss of strength.

The objects of the present invention are to provide a laminated fabric, more particularly double jacketed circular woven hose, constructed to furnish improved resistance to pressure, while affording a minimum of weight and bulk, increased flexibility, and rapid drying characteristics. In the preferred form of the invention, these improvements and advantages are accompanied by a saving in the cost of manufacture of the product.

The invention will be apparent from the following description of a preferred application of the invention, taken in conjunction with the accompanying drawing, in which:

FIG. 1 is an elevational view, partly in section, of flexible hose made in accordance with the invention;

FIG. 2 is a greatly enlarged view of a plied yarn suitably twisted to provide the filler for the inner jacket; and

FIG. 3 is a greatly enlarged view of a plied yarn suitably twisted to provide the filler for the outer jacket.

In accordance with one aspect of the invention, relating

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to flexible hose, as illustrated, there are provided inner circular woven jacket 10 and outer circular woven jacket 12 having fillers 14 and 16 and warps 18 and 20, respectively. The filler yarn 14 for the inner jacket 10 is made with the singles and ply having a twist in the same direction, whereas the singles and ply of the filler yarn 16 for the outer jacket are twisted in opposite directions. The inner jacket filler yarn may have a ZZ twist, as shown in FIG. 2, or an SS twist, and the outer jacket filler has a ZS twist, as shown in FIG. 3, or a SZ twist. The twists imparted to the singles and the plies of both the inner and outer jacket filler yarns are generally in the range of about 0.2 to 5.0 and preferably about 0.5 to 2.0 turns per inch. Advantageously the singles and plying twists of the inner jacket fillers are approximately equal in magnitude to those of the outer jacket filler. The described twist relationship of the inner and outer filler yarns affords a slightly greater breaking elongation for the inner jacket filler, which enables both the inner and outer jackets to absorb their maximum stress without any sacrifice in strength. Also, the problem of close control in fitting the inner jacket within the outer jacket is alleviated.

The assembly and lamination of the two jackets are accomplished in a conventional manner. The inner circular woven jacket 10, having a diameter slightly less than the outer circular woven jacket 12, is pulled, together with a liner or tube of elastic material such as vulcanizable rubber, into the outer jacket. The assembly is then cured by injecting steam under pressure into the rubber lining and maintaining such steam pressure for a sufficient period to cause adhesion of the rubber to the inner jacket 10 and vulcanization of the rubber. The rubber impregnated for the jackets is designated 22.

In the preferred form of the invention, the plied filler yarns for both the inner and outer jackets are of a high tenacity, low elongation fiber, e.g. high tenacity regenerated cellulose or rayon. This fiber is preferred because of its low cost, coupled with high strength, minimal weight and quick drying characteristics. For maximum strength, the high tenacity regenerated cellulose is used as a plied yarn of continuous filaments. Other fibers which may be used for the plied yarns of both the inner and outer jacket fillers, in the twist relationship as above described, can comprise polyesters, such as polyethylene terephthalate; polyamides such as nylon, e.g. polyhexamethylene adipamide; acrylonitrile polymers and copolymers; cellulose acetate; other organic derivatives of cellulose; cotton and the like. The warps are preferably of cotton, although warps of regenerated cellulose, cellulose acetate, polyester, or polyamides may also be used.

In greater detail, and to illustrate the invention in connection with fire hose 2½ inches in diameter, the inner jacket may be woven to provide 252 cotton warps each made by plying 9 singles each of 8.5 cotton count and a filling of 7.5 picks per inch of 7 singles each of 1600 filaments of 1 denier high tenacity, low elongation regenerated cellulose, each singles yarn being twisted 0.8 Z turns per inch and the 7 singles being plied together with 1.2 Z turns per inch. The circular woven outer jacket is provided with 246 cotton warps each made by plying 13 singles each of 8.5 cotton count and a filling of 6.5 picks per inch of high tenacity low elongation regenerated cellulose identical with the inner jacket filling except that the seven singles are plied with 1.2 S turns per inch. A fire hose formed of such inner and outer woven jackets in conjunction with a liner of rubber or rubber-like material meets all the requirements of Underwriters approved 400 p.s.i. proof, 600 p.s.i. minimum burst, 2½" double jacket fire hose. In fact, hose constructed as described furnishes test results which substantially exceed the minimum Underwriters requirements in straight burst, curved

burst, kink burst, and the circle tests as set forth in the Underwriters "Standard for Cotton Rubber-Lined Fire Hose". Also, high values were obtained for knot sample burst and impulse tests.

It will be understood that the foregoing specific construction of flexible hose is given by way of example only. The number and denier of the warps, the number of picks per inch, the number of the singles and the denier of the filler yarns may be varied to suit the strength requirements for the particular application involved.

While the invention has been described as particularly and preferably suitable for tubular articles wherein the twisted reinforcement is laid in on a circular path, numerous advantages of the invention may be realized for uses which do not require that the laminated fabric be in tubular form. The laminated fabric may comprise woven fabrics in juxtaposed relationship in substantially flat form where, for example, the laminate is used for belting, which in normal usage encounters the application of pressure to a side thereof tending to impart a convex or crown effect to the laminate. The substantially flat laminated fabric comprises a pair of woven layers in juxtaposed relationship, with either the picks, or warps, or both in adjacent layers being formed of plied yarns having the twist relationship described for the yarns extending in the same direction; that is either the fillings of both layers, or the warps of both layers, or the fillings and warps of both layers are of the same fiber, and preferably high tenacity, low elongation regenerated cellulose, in the described twist relationship.

The two layers described herein may be employed in conjunction with additional layers of like or different constitution. The performance of the laminate or composite fabric will of course depend upon its entire composition but the two layers made up in accordance with the present invention will share in withstanding a load regardless of the performance of the other layers.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of my invention.

Having described my invention, what I desire to secure by Letters Patent is:

1. A laminated fabric including a pair of woven layers, each layer of said pair including plied yarn extending parallel to plied yarn in the other layer, the singles and plying twists of said plied yarn in one layer being in the same direction, and the singles and plying twists of said plied yarn in the other layer being in opposite directions.

2. A laminated fabric according to claim 1, wherein said plied yarns of both layers are of identical construction except for the opposite twist.

3. A laminated fabric according to claim 1, wherein said plied yarns of both layers are of the same composition.

4. A laminated fabric according to claim 1, wherein said plied yarns of both layers comprise high tenacity, low elongation filamentary material.

5. A laminated fabric according to claim 1, wherein said plied yarns of both layers comprise high tenacity, low elongation regenerated cellulose.

6. A laminated fabric according to claim 1, wherein the singles and plying twists of said plied yarns of both layers are about 0.2 to 5.0 turns per inch.

7. A laminated fabric according to claim 6 wherein the

singles and plying twists of said plied yarns of one of said layers are approximately equal in magnitude to those of the other of said layers.

8. A laminated fabric according to claim 1, wherein the singles and plying twists of said plied yarns of both layers are about 0.5 to 2.0 turns per inch.

9. A laminated fabric according to claim 1 wherein said layer having singles and plying twists in the same direction has a slightly greater breaking elongation than said other layer.

10. A flexible hose comprising inner and outer tubular jackets, each jacket of said hose including plied yarn extending parallel to plied yarn in the other jacket, the singles and plying twists of said plied yarn being in the same direction in the inner jacket and in opposite directions in the outer jacket.

11. A flexible hose comprising inner and outer circular woven jackets each including as the filler a plied yarn of high tenacity, low elongation filamentary material, the singles and plying twists of the filler yarn being in the same direction in the inner jacket and in opposite directions in the outer jacket.

12. A flexible hose according to claim 11, including an elastic liner inside the inner jacket.

13. A flexible hose according to claim 11, wherein both fillers are of identical construction except for the opposite twist.

14. A flexible hose according to claim 11, wherein both fillers comprise high tenacity, low elongation regenerated cellulose.

15. A flexible hose according to claim 11, wherein the warps of the jackets comprise cotton.

16. A flexible hose according to claim 11, wherein the singles and plying twists of both fillers are about 0.5 to 5.0 turns per inch.

17. A flexible hose according to claim 11, wherein the singles and plying twists of both fillers are about 0.5 to 2.0 turns per inch.

18. A flexible hose comprising inner and outer circular woven jackets and an elastic liner inside the inner jacket, each jacket comprising cotton warps and fillers of plied high tenacity, low elongation regenerated cellulose, the singles and plying twists of the filler yarn being in the same direction in the inner jacket and in the opposite direction in the outer jacket, all twists being about 0.5 to 2.0 turns per inch.

19. A flexible hose comprising inner and outer circular woven jackets and a rubber liner inside the inner jacket, each jacket comprising cotton warps and fillers of plied high tenacity, low elongation regenerated cellulose, the singles and plying twists of the filler yarn being in the same direction in the inner jacket and in the opposite direction in the outer jacket, all twists being about 0.5 to 2.0 turns per inch.

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