

UNITED STATES PATENT OFFICE

2,436,979

TIRE CORD AND METHOD OF
MANUFACTURE

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This invention relates to the production of improved tire cord structures which may be used as reinforcing materials in the production of such materials as, for example, reinforced rubber products, rubber tires, reinforced plastic materials, etc. The invention also provides new methods by which such reinforcing materials may be advantageously produced.

The term "cord" or "cord structure" as used herein is intended to include single or multiple strands of twisted filamentary material used primarily as reinforcing materials. The invention may be applied with particular advantage to such cord or cord structures having a denier of at least 500 and in which the cord components have been twisted at least 1.5 turns per inch.

In the production of reinforced rubber products such as, for example, rubber tires, belts, hose and the like, it is common practice to use a twisted cordlike material to reinforce the rubber structure. The cord is commonly made by twisting suitable filamentary material such as, for example, cotton, rayon, nylon, etc., into intermediate strands or directly into final cord structures. Thus, for example, the cord structure may be made by twisting together one or more strands of yarn each of which strands has already been subjected to an initial twisting operation, or the cord structure may consist simply of a heavy strand of a material such as, for example, rayon having a denier in excess of 1500 which has been twisted a desired number of turns per inch.

The twisting operations to which the materials making up the cord are subjected in producing the cord generally result in a reduction in strength of the original yarn. To minimize such loss in strength, it is common practice to apply lubricants or conditioning agents of various types to the yarns before they are subjected to the twisting operation. While such lubricants may be effective to minimize loss in strength resulting from the twisting operations, they in many instances have an adverse effect on the properties of the cord when it is used as a reinforcing material in the production of, for example, rubber tires. For such purposes the reinforcing cord should not only have satisfactory tensile strength, high fatigue resistance, high flex life and excellent heat resistance, but should also have properties such that it can be made to adhere satisfactorily to the rubber structure and also have the capacity to withstand the repeated flexing to which the tire is normally subjected in the course of its use.

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This invention provides a cord structure made from yarns which have been treated with a composition so as to minimize the loss in strength of the yarn due to twisting operations; it provides a cord product which adheres satisfactorily to a rubber structure and it also provides a cord having a high flex life and a high fatigue life.

In general, the new tire cord structure of the invention has a denier of at least 500 and is made from twisted filamentary material which material has been treated with a composition comprising an oil and an ester of a fatty acid containing at least twelve carbon atoms with a polyhydric alcohol such as hexahydric alcohols and their anhydro-derivatives, the ester component having a melting point of at least 30° C. and the oil being present in the composition in a concentration of at least 5% of the aggregate weight of said oil and ester.

The oils employed in the invention may be vegetable, marine, mineral oils or mixtures thereof. Both saturated and unsaturated types of vegetable oils may be employed. Among the vegetable oils may be mentioned linseed, soybean, corn, peanut, castor, rapeseed and olive oils. Among the marine oils that may be used with advantage are sperm oil, whale oil, menhaden oil, etc. Mineral oils having Saybolt viscosities of from 30 to 180 seconds at 100° F. are considered of especial advantage.

The fatty acid ester or, more specifically, the alcoholic residue of such ester may be derived from such polyhydric alcohols as sorbitol, mannitol, dulcitol or the anhydro-derivatives of such alcohols as, for example, sorbitan, mannitan, sorbide, mannide, etc. The fatty acid portion of the ester is advantageously derived from fatty acids containing at least 12 carbon atoms and may include lauric, myristic, palmitic, stearic and unsaturated or hydroxy acids such as oleic, ricinoleic, etc. The esters may be either predominantly mono-, di-, triesters, etc., or mixtures thereof and should advantageously have a melting point above 30° C.

In general, the esters employed are hexitol, hexitan and hexide fatty acid esters such as, for example, hexitol tetrastearate, etc.; hexitan monopalmitate, monolaurate, monooleate, etc.; and hexide monooleate, etc. Among the specific esters which may be employed with advantage may be mentioned sorbitol tetrastearate, sorbitan monopalmitate, sorbitan monolaurate, mannitan monopalmitate, mannide monooleate, etc.

Although the yarn-conditioning agent may be applied to the filamentary material directly in

the molten or undiluted form, it is more advantageously applied in a diluted form such as a solution or dispersion depending somewhat upon the degree of solubility or dispersibility of the components in the medium employed. It is, however, considered more advantageous to treat the filamentary material with an aqueous dispersion of the yarn-conditioning composition. When employing such a treatment, it has been found advantageous to include in the aqueous dispersion a suitable dispersing agent such as, for example, triethanolamine. Other alkaline dispersing agents may be used if desired.

The proportions of the ingredients employed in the yarn-conditioning composition may be varied but, in general, the concentration of the oil present in the composition should be at least 5% of the aggregate weight of the oil and the partial polyester. If the composition is used in the form of an aqueous dispersion, the aggregate concentration of the oil and partial polyester in the dispersion is advantageously from about 0.05% to about 5.0%, by weight. It has been found particularly advantageous to use concentrations of about 0.3% to 3.0%. In general, the aqueous dispersions may be prepared by melting the partial polyester and mixing therewith the oil or mixture of the oils together with a small amount of a dispersing agent such as triethanolamine, then adding and mixing water in an amount sufficient for any desired concentration and, finally, passing the mixtures through a colloid mill.

The yarn-conditioning composition is applied to the filamentary material prior to the various yarn twisting and cord construction operations and the treated filamentary material may, if desired, be dried before being subjected to twisting. In the production of textile yarns and cord structures from materials such as continuous multifilament viscose rayon yarn, it is particularly advantageous to treat the yarn before it has been subjected to the first drying step normally incident to its production. This may be done with especial advantage when the viscose rayon is produced by the continuous process as described, for example, in Torrence Patent No. 2,284,497 by applying the yarn-conditioning emulsion or dispersion to the viscose rayon just prior to the delivery of the yarn to the drying reel on which the yarn is continuously dried prior to twisting. The amount of the yarn-conditioning composition deposited on the yarn as a result of the treatment advantageously ranges from about 0.1% to 4.5%, by weight, of the yarn.

The invention will be more fully described by reference to the following examples although it is to be understood that the invention is not limited thereto.

Example 1

20 parts of sorbitan monopalmitate are melted and mixed with 0.2 part of triethanolamine and the mixture heated to about 60° C. 80 parts of corn oil are added and thoroughly mixed by stirring while maintaining the temperature of the mixture at about 60° C. While the mass is maintained at this temperature, 300 parts of water at room temperature are added and thoroughly mixed. The aqueous mixture is then passed through a Manton-Gaulin Company colloid mill having a clearance setting of about 0.013 inch to yield a dispersion of about 25% concentration, by weight. The dispersion is then diluted with sufficient water so that it contains about 0.35%, by weight, of the oil and ester ingredients.

The above dispersion is applied to a wet, freshly spun and processed 1100-denier, 480-filament viscose rayon yarn while it is being temporarily stored on a thread-advancing, thread-storage reel just prior to the drying stage of a continuous rayon spinning and processing machine as described, for example, in Torrence Patent No. 2,284,497. The yarn is treated for about ten to fifteen seconds. The treated yarn is then continuously advanced to a succeeding thread-advancing, thread-storage device upon which it is dried. Thereafter, the yarn is given about 1.5 turns per inch of Z-twist and collected on a spool. The resulting yarn thereafter has its twist increased to about 14 turns per inch of Z-twist and two strands of the resulting Z-twisted yarn are then plied together with about 11½ turns per inch in the opposite direction (S-twist). Ether extraction of the resulting cord shows that about 0.33% by weight, of the composition ingredients are present on the filamentary material used in forming the cord. The cord has high tensile strength and excellent fatigue resistance.

Example 2

A 0.35%, by weight, aqueous dispersion is prepared in the manner and under the conditions set forth in Example 1 but using instead 30 parts of mannitan monopalmitate, 0.3 part triethanolamine and 70 parts of castor oil. The conditioning agent so prepared is applied in a manner similar to Example 1 but with the exception that the 1100-denier, 480-filament thread is given a total of about 17 turns per inch Z-twist and the two ends thereof plied with about 11½ turns per inch S-twist. The cord exhibits desirable tensile strength and fatigue resistance qualities.

Example 3

A 0.35%, by weight, aqueous dispersion is prepared, applied to a viscose rayon yarn and a cord made all in the manner and under the conditions set forth in Example 1 but using instead the following ingredients: 40 parts of sorbitol tetra-stearate, 0.4 part of triethanolamine and 60 parts of peanut oil.

Example 4

A 0.35%, by weight, aqueous dispersion is prepared, applied to a viscose rayon yarn and a cord made all in the manner and under the conditions set forth in Example 1 but using instead the following ingredients: 60 parts of sorbitan monopalmitate, 0.6 part of triethanolamine, 20 parts of linseed oil and 20 parts of olive oil.

Example 5

A 0.35%, by weight, aqueous dispersion is prepared, applied to a viscose rayon yarn and a cord made all in the manner and under the conditions set forth in Example 1 but using instead the following ingredients: 60 parts of sorbitan monopalmitate, 0.6 part of triethanolamine and 40 parts of a mineral oil having a Saybolt viscosity at 100° F. of 80" to 90".

Example 6

20 parts, by weight, of sorbitan monopalmitate; 40 parts, by weight, of peanut oil; and 40 parts, by weight, of a mineral oil having a Saybolt viscosity at 100° F. of about 110" are heated to about 60° C. to melt the sorbitan monopalmitate component and effect a homogeneous solution. This composition, while in a molten fluid state at a temperature between about 50° C. and 60° C. is applied to dried, untwisted 2200-denier, 960-

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filament viscose rayon yarn. The treated yarn is twisted about 5 turns per inch and thereafter the twist is set. The cord structure thus formed exhibits high fatigue resistance and desirable tensile strength.

Example 7

A 0.35%, by weight, aqueous dispersion is prepared, applied to a viscose rayon thread and a cord made all in the manner and under the conditions set forth in Example 1 but using instead the following ingredients: 20 parts of sorbitan monopalmitate, 0.2 part of triethanolamine and 80 parts of whale oil.

Example 8

A 0.35%, by weight, aqueous dispersion is prepared, applied to a viscose rayon thread and a cord made all in the manner and under the conditions set forth in Example 1 but using instead the following ingredients: 50 parts of sorbitan monopalmitate, 0.5 part of triethanolamine and 50 parts of sperm oil.

Similar dispersions are prepared and applied to viscose rayon thread in accordance with Example 1 employing as oils: soybean oil, rapeseed oil, and menhaden oil. The cord produced from thread so treated show desirable tensile strength and fatigue resistance characteristics.

Although the foregoing examples have illustrated the application of the invention to cord structures from 1100-denier filament rayon, it is to be understood that the invention is not intended to be limited thereto. The invention may be employed with advantage in producing yarns and cord structures of other deniers made from any natural or artificial organic filamentary material.

The invention may be applied with particular advantage to cord structures made by plying together two or more strands of filamentary material, each having a denier of at least 1000 and in which the strands have been given a twist in one direction of from about five to twenty turns per inch and in which the twisted strands have then been plied into a cord by giving them a ply twist in the opposite direction of about five to fifteen turns per inch.

The invention may also be applied to the production of cords from filamentary material having a denier of at least 1500 which is subjected to at least one and one half turns per inch of twist, including such structures as are described, for example, in Patent No. 2,103,245 to E. G. Budd.

Although the invention may be used with particular advantage in the production of cord structures from viscose rayon, it is also applicable to the production of such materials from other types of filamentary materials. These may include, for example, natural or artificial organic filamentary materials among which may be mentioned such natural cellulosic filamentary materials as cotton, flax, hemp, ramie, etc., and such artificial yarns as those made from regenerated cellulose by the viscose or cuprammonium process as well as cellulose ethers and cellulose esters, the latter including cellulose acetates and deacetylated cellulose acetate fibers.

The invention may also be employed with such artificial organic filamentary materials as those produced from polymerized polyamides, e. g., nylon, or from hydrocarbon polymers or their derivatives including vinyl, vinylidene and styrene polymers.

When reinforcing cord structures such as those made, for example, from viscose rayon are used

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in the fabrication of rubber products such as tires, it is common practice to dip the rayon cord structure in an aqueous latex solution prior to its incorporation in the rubber tire. This operation is performed to promote better adhesion between the cord structure and the rubber tire carcass. Due to the aqueous nature of the latex-dip solution and other conditions in this operation, some yarn lubricants interfere with the absorption of the proper amount of latex solution by the cord structure and they are said to have poor "dip take-up" characteristics. The new cord structures of this invention, however, have satisfactory "dip take-up" characteristics and adhere remarkably well to the tire structures in which they are incorporated. The improved fatigue life, high flex life, and excellent tensile strength of the new cord structures make possible the production of rubber tires having improved operating characteristics. The new cord structures also have excellent heat resistance and are comparatively less sensitive to high humidity conditions.

We claim:

1. The method of producing a tire cord having a denier of at least 500 which comprises treating a filamentary material with a composition comprising (a) an oil selected from the group consisting of vegetable, marine and mineral oils, and (b) an ester of a fatty acid containing at least 12 carbon atoms with a polyhydric alcohol selected from the group consisting of hexahydric alcohols and the anhydro-derivatives of such alcohols; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of said oil and ester; said ester component (b) having a melting point of at least about 30° C.; said filamentary material being treated so that it contains about 0.1% to 4.5%, by weight, of said composition based on the weight of said filamentary material; and thereafter twisting said treated filamentary material at least 1.5 turns per inch to form said cord.

2. The method of producing a tire cord having a denier of at least 500 which comprises treating cellulosic filamentary material with a composition comprising (a) an oil selected from the group consisting of vegetable, marine and mineral oils, and (b) an ester of a fatty acid containing at least 12 carbon atoms with a polyhydric alcohol selected from the group consisting of hexahydric alcohols and the anhydro-derivatives of such alcohols; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of the said oil and ester; said ester component (b) having a melting point of at least about 30° C.; said filamentary material being treated so that it contains about 0.1% to 4.5%, by weight, of said composition, based on the weight of said filamentary material; twisting individual strands of said treated filamentary material at least 1.5 turns per inch in one direction and thereafter twisting together a plurality of said treated and twisted strands in the opposite direction to form said tire cord.

3. The method of producing a tire cord having a denier of at least 1000 which comprises treating regenerated cellulose filamentary material with a composition comprising (a) an oil selected from the group consisting of vegetable, marine and mineral oils, and (b) an ester of a fatty acid containing at least 12 carbon atoms with a hexitan polyhydric alcohol; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of the said oil and ester;

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said ester component (b) having a melting point of at least about 30° C.; said filamentary material being treated so that it contains about 0.1% to 4.5%, by weight, of said composition based on the weight of said filamentary material; twisting said treated filamentary material at least 1.5 turns per inch to form said tire cord.

4. The method of producing a tire cord having a denier of at least 1000 which comprises treating regenerated cellulose filamentary material with an aqueous dispersion of a composition comprising sorbitan monopalmitate and an oil selected from the group consisting of vegetable, marine and mineral oils; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of said oil and ester; drying said treated filamentary material; said filamentary material being treated so that it contains about 0.1% to 4.5%, by weight, of said composition, based on the normally dry weight of said filamentary material; twisting individual strands of said treated filamentary material at least 1.5 turns per inch in one direction and thereafter twisting together a plurality of said treated and twisted strands in the opposite direction to form said tire cord.

5. The method of producing a tire cord having a denier of at least 1000 which comprises treating regenerated cellulose filamentary material with an aqueous dispersion of a composition comprising sorbitol tetrastearate and an oil selected from the group consisting of vegetable, marine and mineral oils; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of said oil and ester; drying said treated filamentary material; said filamentary material being treated so that it contains about 0.1% to 4.5%, by weight, of said composition, based on the normally dry weight of said filamentary material; twisting individual strands of said treated filamentary material at least 1.5 turns per inch in one direction and thereafter twisting together a plurality of said treated and twisted strands in the opposite direction to form said tire cord.

6. The method of producing a tire cord having a denier of at least 1000 which comprises treating regenerated cellulose filamentary material with an aqueous dispersion of a composition comprising mannide mono-oleate and an oil selected from the group consisting of vegetable, marine and mineral oils; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of said oil and ester; drying said treated filamentary material; said filamentary material being treated so that it contains about 0.1% to 4.5%, by weight, of said composition, based on the normally dry weight of said filamentary material; twisting individual strands of said treated filamentary material at least 1.5 turns per inch in one direction and thereafter twisting together a plurality of said treated and twisted strands in the opposite direction to form said tire cord.

7. A tire cord having a denier of at least 500 and made from twisted filamentary material, said filamentary material having been treated with a composition comprising (a) an oil selected from the group consisting of vegetable, marine and mineral oils, and (b) an ester of a fatty acid containing at least 12 carbon atoms with a polyhydric alcohol selected from the group consisting of hexahydric alcohols and the anhydro-derivatives of such alcohols; said oil being present in said composition in a concentration of at least

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5% of the aggregate weight of said oil and ester; said ester component (b) having a melting point of at least about 30° C.; said filamentary material having been treated so that it contains about 0.1% to 4.5%, by weight, of said composition based on the weight of said filamentary material.

8. A tire cord having a denier of at least 500 and made from twisted and plied strands of cellulosic filamentary material, said filamentary material having been treated with a composition comprising (a) an oil selected from the group consisting of vegetable, marine and mineral oils, and (b) an ester of a fatty acid containing at least 12 carbon atoms with a polyhydric alcohol selected from the group consisting of hexahydric alcohols and the anhydro-derivatives of such alcohols; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of said oil and ester; said ester component (b) having a melting point of at least about 30° C.; said filamentary material having been treated so that it contains about 0.1% to 4.5%, by weight, of said composition based on the weight of said filamentary material.

9. A tire cord having a denier of at least 1000 and made from twisted cellulosic filamentary material, said filamentary material having been treated with a composition comprising (a) an oil selected from the group consisting of vegetable, marine and mineral oils, and (b) an ester of a fatty acid containing at least 12 carbon atoms with a hexitan polyhydric alcohol; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of said oil and ester; said ester component (b) having a melting point of at least about 30° C.; said filamentary material having been treated so that it contains about 0.1% to 4.5%, by weight, of said composition based on the weight of said filamentary material.

10. A tire cord having a denier of at least 1000 and made from twisted and plied strands of regenerated cellulose filamentary material, said filamentary material having been treated with a composition comprising sorbitan monopalmitate and an oil selected from the group consisting of vegetable, marine and mineral oils; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of said oil and ester; said filamentary material having been treated so that it contains about 0.1% to 4.5%, by weight, of said composition based on the weight of said filamentary material.

11. A tire cord having a denier of at least 1000 and made from twisted and plied strands of regenerated cellulose filamentary material, said filamentary material having been treated with a composition comprising sorbitol tetrastearate and an oil selected from the group consisting of vegetable, marine and mineral oils; said oil being present in said composition in a concentration of at least 5% of the aggregate weight of said oil and ester; said filamentary material having been treated so that it contains about 0.1% to 4.5%, by weight, of said composition based on the weight of said filamentary material.

12. A tire cord having a denier of at least 1000 and made from twisted and plied strands of regenerated cellulose filamentary material, said filamentary material having been treated with a composition comprising mannide mono-oleate and an oil selected from the group consisting of vegetable, marine and mineral oils; said oil being present in said composition in a concentration of

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at least 5% of the aggregate weight of said oil and ester; said filamentary material having been treated so that it contains about 0.1% to 4.5%, by weight, of said composition based on the weight of said filamentary material.

13. A re-enforced rubber structure comprising a tire cord as defined in claim 7.

14. A re-enforced rubber structure comprising a tire cord as defined in claim 9.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,985,687	Nuesslein	Dec. 25, 1934

10

Number

Name

Date

2,039,279
2,079,108
2,089,187
2,116,064
2,122,593
2,144,354
2,150,569
2,150,570
2,151,952
2,201,992
2,297,135

Bouhuys	May 5, 1936
Dreyfus	May 4, 1937
Dreyfus et al.	Aug. 10, 1937
Dreyfus et al.	May 3, 1938
Stafford	July 5, 1938
Whitehead	Jan. 17, 1939
Whitehead	Mar. 14, 1939
Whitehead	Mar. 14, 1939
Wasum	Mar. 28, 1939
Dreyfus et al.	May 28, 1940
Davis	Sept. 29, 1942

OTHER REFERENCES

15 "Spans and Tweens," Atlas Powder Co., Dec. 1943, pp. 1, 2, 11-14 and 16.

Certificate of Correction

Patent No. 2,436,979.

March 2, 1948.

GEORGE P. STANDLEY ET AL.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Column 2, lines 15 and 34, column 6, lines 33 and 52, column 7, lines 73 and 74, and column 8, line 17, for "anhydro-derivatives" read *anhydro derivatives*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 15th day of June, A. D. 1948.

[SEAL]

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