Nov. 12, 1940. H. Y. JENNINGS 2,220,958

TENSIONED YARN AND THREAD AND METHOD OF FORMING SAME

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Fig. 1

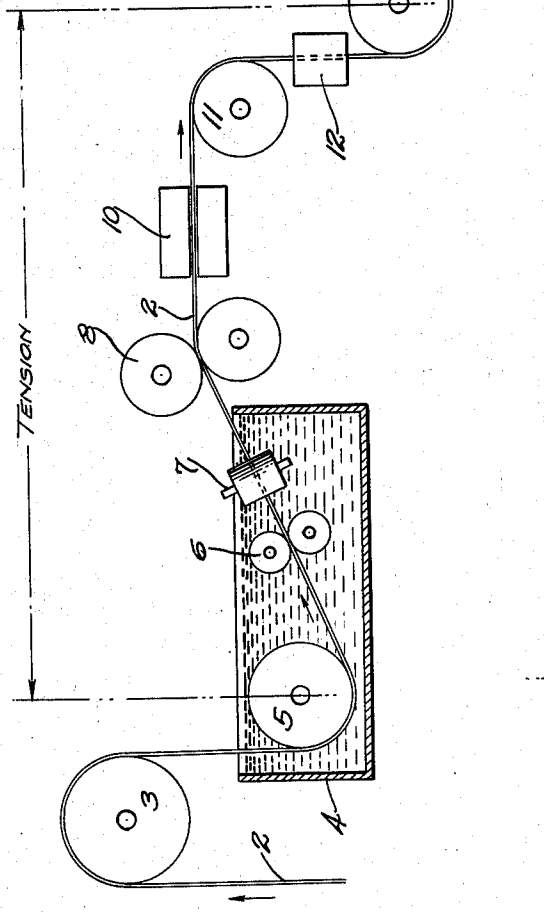
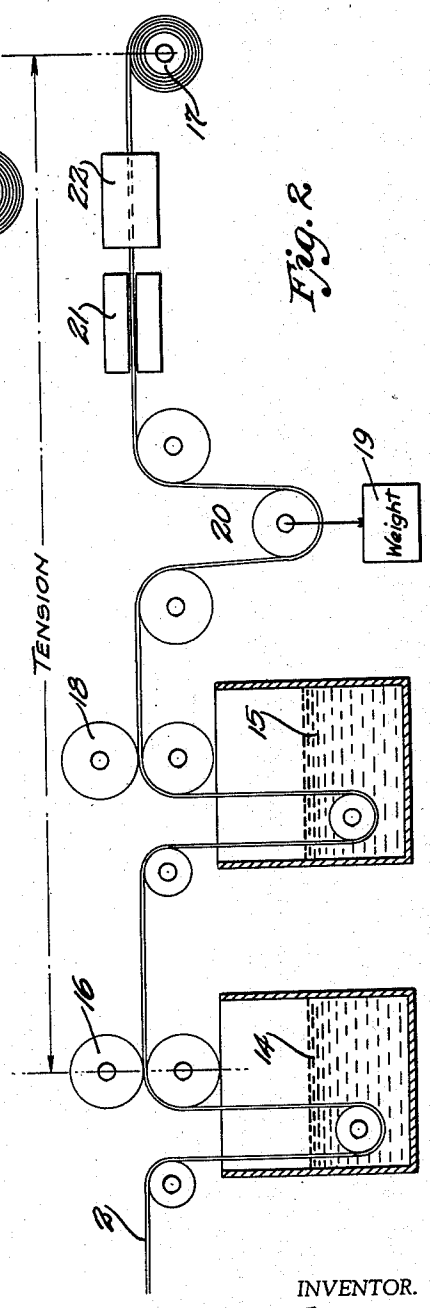


Fig. 2



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TENSIONED YARN AND THREAD AND METHOD OF FORMING SAME

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14 Claims. (Cl. 28—1)

This invention has to do with tensioned yarns and threads and method of forming the same, and has to do particularly with the processing and mechanical treatment of yarns, threads, ropes and the like, made from vegetable and animal fibers, and the product resulting from said processing and mechanical treatment.

The present invention is particularly applicable to vegetable and animal fibers, for example, cotton and wool, which depend upon the twisting together of separate fibers for their formation and strength. For years, throughout the entire yarn making industry, attempts have been made to treat or dope yarns and threads with starches, waxes and various other plastics and liquids in an attempt to increase their tensile strength. In many cases this doping was so extensive as to make the thread as stiff as a wire and yet the actual tensile strength on testing the same showed no appreciable increase over the untreated thread. A notable example of this is the shoe industry where all the better grades of shoes are sewed with linen threads because of relatively low tensile strength and stretchability of cotton threads.

It is the object of the present invention to combine a processing or treating step with a mechanical working and handling whereby to set up a new relationship between the fibers of the yarn or thread. Success of the present method of treating yarns and threads relies very little on the material used for treating, under which theory most of the attempts in the past have been directed; it depends almost entirely upon the time of application of the treating material and the condition of the yarn or thread, and the maintenance of this condition, during the time of application.

I have discovered that the tensile strength of yarns or threads may be materially increased if each fiber of a yarn or each yarn of a thread is treated with a bonding material and pulled into its proper position to equalize the load on the entire yarn or thread before the bonding material is allowed to set, and then allowing the bonding material to set while the fibers or yarns are held in this equalized tension position. The important feature here is that the fibers or yarns are held in their equalized tension positions by the bonding material after the applied tension is removed. The direct result of this processing and mechanical treatment is the production of a thread, all the individual yarns of which take an equal amount of the load when the thread is placed under tension in actual use.

Other features of the invention have to do with various detailed steps of processing and mechanical treatment and with the manner of applying treating material to the fibers and yarns as will be more clearly brought out in the specification and claims.

In the drawing:

Fig. 1 is a diagrammatic flow chart illustrating the combined and simultaneous application of the processing and mechanical steps on a thread.

Fig. 2 is a flow chart illustrating modified processes and mechanical steps of treating and setting the thread under tension.

In the formation of yarns, threads, ropes and the like from vegetable and animal fibers, the many hundreds of small fibers are packed together, twisted, straightened and twisted many times to form single strands, and two or more of the single strands twisted to form yarns. Certain numbers of these standard yarns are then twisted together to form multiple ply threads. The present invention has to do particularly with a thread, although it is applicable to the individual yarns, and in describing the invention I have described the same in treating and processing that type of threads known as shoe threads.

The processing and mechanical steps, in fact the product itself, may be best understood by following through the method steps as illustrated in the flow chart in Fig. 1. Assuming that the shoe thread 2 is a nine yarn thread, this is fed over a roller 3 and into a tank 4 filled with treating solution. The thread is preferably fed through this treating solution at a relatively low speed so as to obtain as great a penetration as possible. As shown in Fig. 1, the thread is fed under a roller 5 rotating at a given speed and then through squeeze rolls 6 and 7 positioned at right angles to each other. The purpose of these squeeze rolls operating in the bath of treating solution is to insure as great a penetration of the treating solution into the thread and around the fibers as possible.

A set of squeeze rolls 8 is positioned outside the tank to remove surplus treating material. In order to place the thread being treated under tension and, in fact, to positively stretch this thread, a roll 9 is preferably rotated at a sufficiently higher speed than the R. P. M. of the roll 5 so as to place the entire length of thread between the roll 5 and the roll 9 under tension; this tension being so great as to positively stretch the thread and maintain the same in such stretched position. In the preferred method, tension is set up between the rolls 5 and 9 to very closely ap-

proximate the breaking point of the untreated thread. The thread 2, after passing through the squeeze rolls 8 is next preferably passed through a heating medium diagrammatically illustrated as at 10. Here the treating material is set as its first important step in fixing the equalized fibers and yarns in their relative stretched tensioned position. The treated thread with the set treating material may then pass over a roll 11 and through a cooling zone diagrammatically represented as at 12. This cooling of the set treated material is an added step to positively fix the threads in their equalized tensioned positions, the thread still being maintained under the relatively great tension during the cooling step. The finally treated thread may then be wound up in the usual manner on a roll 13. It will be obvious that by this process a large number of threads can be simultaneously treated.

It will be understood that most any artificial integument or bonding material may be used in treating the yarns and threads. This material may be placed in the form of an emulsion, solution or any standard manner of getting the bonding material into and around the individual yarns and fibers. I prefer to use that type of treating solution in which a water insoluble artificial integument is dispersed in water by a small amount of organic solvent, the organic solvent having a preferential adsorption for the yarns and fibers of the thread, with the result that the artificial integuments are carried onto and around the fibers of the yarns to an unusually great extent because of the preferential adsorption properties of the organic solvent.

The following examples of treating solutions are adapted for use as a bonding material in my process:

Example 1.—It has been found satisfactory to use as a colloid material a product consisting of 2 parts of ester gum, 2 parts polymerized linseed oil and 1 part oleic acid. Ordinary linseed oil is heated to a temperature of about 220° C. and is held at this temperature for about four hours until gelatin begins. Ester gum which has been heated to the liquid condition is then added, after which the oleic acid is added. Upon cooling the material sets to a firm hard mass; this is put into solution by adding 8 parts of organic solvent consisting of equal volume of benzine and carbon tetrachloride. To prepare the final processing solution, the organic liquid solution described is added, slowly and with constant stirring, to 88 (or more) parts of water to which has previously been added 1½ parts by volume of 26° aqua ammonia. There is thus obtained a white solution (emulsion) containing the colloidal resins dissolved in droplets of organic solvent which are highly dispersed throughout an aqueous medium.

Example 2.—A preferred solution may be prepared by adding eighty parts of commercial alcohol preferably containing not more than 10% of water, denaturing or other impurities, to 18 parts of a rich varnish of gum shellac, such as the shellac in alcohol of commerce, consisting of a viscid solution in alcohol of orange or white gum shellac. To the above ingredients I prefer to add two parts of castor oil, more or less for the purpose of somewhat decreasing the stiffness and resiliency of the colloid coating resulting when the volatile ingredients have been evaporated, and especially somewhat to lessen the effect of stiffness after pressing with heat.

10 cc. of this, the above solution is added with constant and vigorous stirring to 90 cc. of water. This gives a white fluid of milky appearance containing the fine particles of water insoluble shellac in a high degree of dispersion in the aqueous medium. The liquid is now ready for use.

Example 3.—10 grams ester gum are dissolved in 90 cc. of acetone. Plasticizing or softening agents such as 2 cc. of castor oil are added at this stage. This solution is poured slowly into water with vigorous stirring. A white liquid of milky appearance containing the fine particles of insoluble ester gum highly dispersed (in colloidal solution) is obtained.

Example 4.—50 grams of "Amberol" (synthetic resin), heat to melt at temperature of approximately 150° C. Add 2 cc. butyl stearate or 2 cc. castor oil. Cool to room temperature. Add 250 cc. of carbon tetrachloride which will give a viscous solution. Add this solution with vigorous stirring to 500 cc. of water. This gives a white fluid of milky appearance containing the synthetic resin and organic solvent droplets in a high degree of dispersion. The liquid is now ready for use.

In using any of the above bonding solutions, as thin a solution as possible is used, as long as sufficient bonding action is later obtained to hold the respective yarns and fibers in their relatively stretched positions. This thinness is important in that as great a penetration of the yarns and fibers as possible is desirable.

It will be understood that the individual yarns going to make up a thread may be treated and then, while the yarn is still wet, twisted and stretched. While thus stretched the bonding material is allowed to set so as to permanently hold the respective yarns in their relative stretched positions. This method of treating the yarns first is to give slightly more penetration, but hardly enough more to compensate for the added work involved for treating before twisting. In some cases it may be found desirable to give the length of thread being treated a positive twisting action in addition to the stretching action; however, in most cases this will not be necessary because it is the putting of all of the yarns under an equal tension that is the gist of the present invention. It will be obvious that in any normal thread, say, of nine yarns, that one or two of these yarns is under a greater normal tension than the others, with the result that when such a normal untreated thread is placed under load, at least one or two yarns will break before the others and then the following yarns will break successively. In the present invention the thread is so stretched, almost to its breaking point, that all of the yarns on the thread are placed under the same tension; for instance, a two foot cotton thread of nine yarns will stretch about two inches in applying the present process. While the yarns are in this equalized stretched position, the coating substance is caused to harden around the individual yarns and fibers so as to positively fix and set the respective yarns in their equalized tensioned positions. Now if load is applied all of the yarns will break at once. As an example of this greatly increased tensile strength of a thread because of fixing the respective yarns in their equalized tensioned positions, the following is illustrative: a great number of lengths of thread were taken from the same spool of standard cotton thread, half being treated by the present process and half being standard untreated. All tests were made on a

Scott testing machine and an average taken of all the tests. The average breaking point for a nine yarn untreated thread was 63 pounds; the average breaking point of the same thread treated was 98 pounds. The average breaking point for a ten yarn untreated thread was 65 pounds; the average breaking point of the same ten yarn treated thread was 110 pounds. The average breaking point of an eleven yarn thread untreated was 73.3 pounds; the average breaking point of the same eleven yarn treated thread was 118 pounds.. The net result of my treatment is that I can produce a cotton shoe thread of greater tensile strength than the same size linen thread.

A modified method of processing and handling thread is diametrically illustrated in Fig. 2. Here the thread 2 is passed through successive treating solutions 14 and 15, the purpose being to obtain as great a penetration as possible. Tension sufficient to stretch the thread substantially to its limit is maintained between the squeeze roll 16 and the winding roll 17. A second set of squeeze rolls 18 is positioned above the second solution tank. In order to maintain a predetermined tension upon the thread so as to just keep under the breaking point of the thread, the weight 19 is suspended from a roller 20. Individual weights may be used for each thread or one weight may take care of a plurality of threads. Heating and cooling means are diagrammatically illustrated as at 21 and 22, respectively.

Various advantages which flow from threads processed and treated according to the present invention include the following: The thread and yarns being wet during the stretching step, and then hardened and fixed during this same stretching step, are not only permanently set as to equalized tension but also set as to twisting. Ordinarily untreated thread has to be very carefully handled when loose and unwound because it is liable to untwist. The process results in an actual increase in tensile strength over the same material unprocessed of from 20% to 70%. The diameter of the treated thread is decreased making the thread weigh less per foot than the untreated thread and, as the surface of the treated thread is smooth, it will be obvious that much better sewing action will be obtained, as far as shoe threads are concerned. The normal stretch of the thread is decreased from 30% to 60% this being a very important feature in connection with cotton shoe thread as it eliminates difficulties now obtained from cotton shoe threads and resulting in what is called a "gapping sole" in the shoe. The processing of the threads according to Examples 1 to 4 makes them water resistant and vermin proof, and also chemical resistant; the processes of Examples 1 and 4 being preferable as to chemical resistance properties. Inasmuch as the fibers are all bonded together this materially decreases the tendency to cut and wear through. The same fiber coating by the treating materials tends to greatly increase the resistance against surface abrasive wear. The yarns are given a marked gloss or polish when processed with any of the four solutions above recited, thus eliminating dressing or final finishing processes. The greatly increased tensile strength of thread processed according to the present invention is not only indicated in the breaking point when tested on a Scott testing machine but as also indicated by the fact that when the processed thread breaks it snaps square off at the breaking point whereas in an unprocessed thread one yarn will invariably break first and then one or more other yarns progressively break producing a decidedly ragged break.

It will be understood that the flow charts of Figs. 1 and 2 are largely diagrammatic and that in actual practice most of the stretch in the Fig. 1 layout would be between the squeeze rolls 8 and the roll 9 and for practical purposes there would be two opposed rolls 9 instead of one; for practical purposes the stretch between rolls 5 and 8 is not important as penetration of the solution into the fibers of the thread can be efficiently accomplished when there is no stretch on the thread. Likewise in Fig. 2, in practical operation most of the stretch would take place between the rolls 18 and 17; in other words, stretch is important during the setting up of the bonding material whereas penetration is more important in the initial treating of the thread.

It will be understood that the terms "set," "harden," and "fixed" as used in describing the bonding material in the description of the invention and appended claims are used interchangeably. In every case they cover the change of state of the bonding material to a substantially solid condition.

What I claim is:

1. As a new article of manufacture, a tensioned thread, the individual yarns and fibers of which are held under a positive longitudinal tension and under a substantially equal tension by a bonding material deposited from a relatively thin bonding solution and hardened around the individual yarns and fibers, whereby when the thread is placed under load each individual yarn will share equally in distribution of such load.

2. As a new article of manufacture, a tensioned thread, the individual yarns of which are stretched to substantially their breaking point and permanently maintained in this stretched position by an artificial integument bonding material deposited from a liquid carrying vehicle and hardened around the individual yarns and fibers.

3. As a new article of manufacture, a tensioned thread, the individual yarns of which are stretched to substantially their breaking point and permanently maintained in this stretched position by a solid bonding material deposited from a relatively thin bonding solution and hardened around the individual yarns and fibers.

4. The method of treating textile yarns, threads and the like to increase the tensile strength and decrease the stretch thereof, which comprises stretching a thread to place the individual elements making up the thread under a tension closely adjacent the breaking point, permeating the thread and individual fibers and yarns with a thin treating solution and permanently setting the threads in this position by a bonding agent comprising an artificial integument.

5. The method of treating textile yarns, threads and the like to increase the tensile strength and decrease the stretch thereof, which comprises treating the individual fibers of the yarn with a bonding material comprising an aqueous dispersion of a water insoluble artificial integument and an organic solvent, stretching the yarn while so treated to a point where the load on each fiber is substantially uniform, and allowing the bonding material to harden while the yarn is still stretched, whereby the individual fibers will uniformly distribute a subsequent load.

6. The method of treating textile yarns,

threads and the like, which comprises stretching a thread just below its breaking point to place the individual elements making up the thread under substantially uniform tension, and permanently setting the threads in this position by a bonding agent comprising an aqueous dispersion of a water insoluble artificial integument and an organic solvent.

7. The method of treating a cotton thread, and permanently and simultaneously increasing the tensile strength and decreasing the stretch thereof, which comprises permeating the thread and the individual fibers and yarns thereof with an artificial integument insoluble in water, stretching the individual yarns of the thread to substantially their breaking point and then allowing the artificial integument to harden as a thin film around the individual fibers and yarns whereby to form a protective coating for the fibers and to maintain the fibers and yarns in their stretched position after the stretching tension has been removed.

8. As a new article of manufacture, a tensioned cotton thread, the individual yarns of which are stretched to substantially their breaking point and permanently maintained in a stretched position by a solid bonding material deposited around the individual yarns and fibers by a relatively thin liquid vehicle and hardened around the individual yarns and fibers.

9. The method of treating cotton textile yarns, threads and the like, which comprises stretching a thread just below its breaking point to place the individual elements making up the thread under substantially uniform tension, permeating the thread and individual fibers and yarns with a thin treating solution, permanently setting the threads in a stretched position by a bonding agent, and removing the treating solution.

10. The method of treating formed fibers, such as yarns, threads, ropes and the like, and permanently increasing the tensile strength and decreasing the stretch thereof, which comprises permeating the individual elements making up the yarn or the like with a thin solution containing a bonding agent, stretching the individual elements of the yarn and the like to substantially their breaking point and then allowing the bonding agent to set up as a thin film around the individual elements whereby to form a protective coating for the individual elements and to maintain the same in their stretched position after the stretching tension has been removed.

11. The method of treating cotton yarns and the like, to permanently and simultaneously increase the tensile strength and decrease the stretch thereof, which comprises saturating the cotton yarn with a bonding material carried by a liquid vehicle, twisting and stretching the wet yarns under a tension just short of the breaking point, removing the liquid vehicle and allowing the bonding material to set while the yarn is still twisted and stretched whereby to permanently hold the respective yarns in their relative stretched positions.

12. The method of treating textile yarns, threads and the like, which comprises forcing a thin treating solution into the yarn or thread and around the individual fibers of the yarn to obtain as great a penetration as possible, depositing a bonding material adapted to harden around the individual yarns and fibers, stretching the yarn while so treated, allowing the bonding material to harden around the individual fibers while the yarn is still stretched, and cooling the bonding material while the yarn is still stretched whereby the bonding material acts as the effective agent to hold the fibers of the yarn in their tensioned position.

13. The method of treating yarns, threads and the like, which comprises permeating said yarns, threads and the like with a relatively thin treating liquid to insure penetration of the solution into the yarns, threads and the like and around the individual fibers thereof, depositing bonding material onto and around the fibers of the yarns and threads, stretching the saturated yarns, threads and the like substantially to the breaking point while wet and before the bonding materials are set, to place the individual elements composing the yarns, threads and the like under substantially uniform tension, and permanently setting the yarns, threads or the the like in a stretched condition by hardening the bonding material around the individual yarns and fibers.

14. As a new article of manufacture, a tensioned cotton yarn or rope, the individual components of which are stretched to substantially their breaking point and permanently maintained in a stretched condition by solid moisture resistant and chemical resistant bonding material deposited around and impregnating the individual components and fibers per se and hardened around said individual components and fibers making up the yarn or rope.

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