Sept. 26, 1939. A. BURGENI 2,173,997

METHOD OF TREATING SEWING THREAD AND THE THREAD RESULTING THEREFROM

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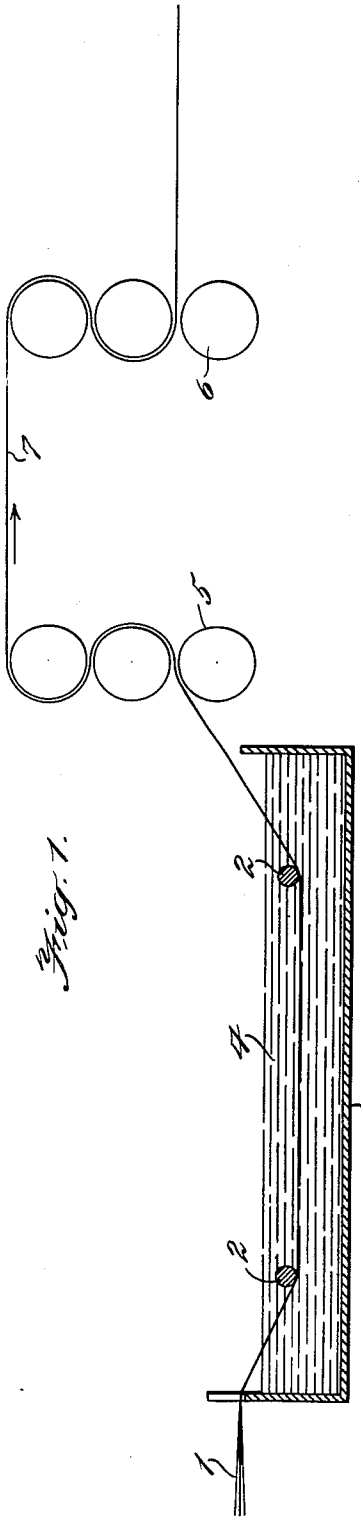


Fig. 1.

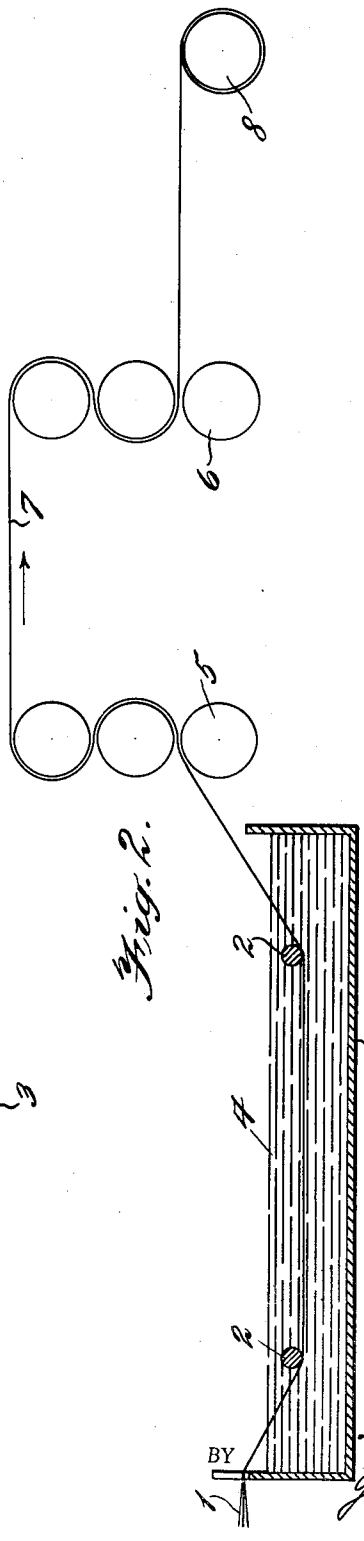


Fig. 2.

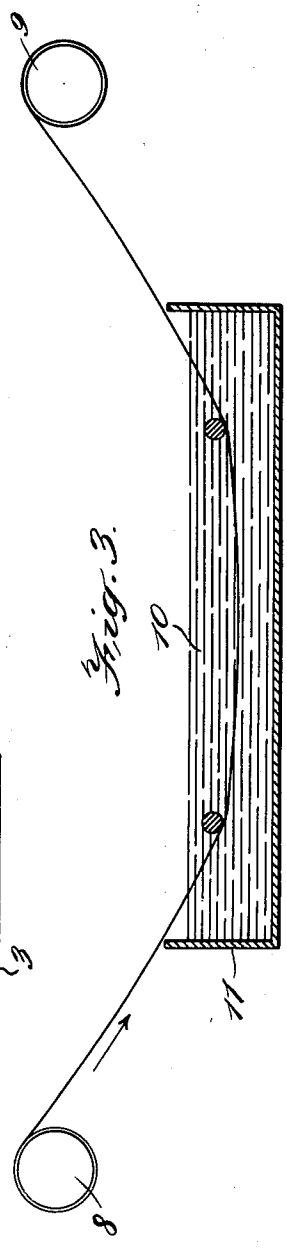


Fig. 3.

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METHOD OF TREATING SEWING THREAD AND THE THREAD RESULTING THEREFROM

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17 Claims. (Cl. 28—1)

This invention relates to a novel and improved method of treating sewing thread and to the thread resulting therefrom. The novel features of the method and thread will be best understood from the following description and the annexed drawing, in which I have shown selected types of apparatus with which the method may be practiced and in which:

Fig. 1 is a diagrammatic view of an apparatus which may be used in the practice of the method;

Fig. 2 is a view similar to Fig. 1, but showing part of an apparatus which may be used in the practice of the invention according to a somewhat different method;

Fig. 3 is a diagrammatic view of an apparatus which may be used in conjunction with the apparatus of Fig. 2.

Primarily, my invention relates to the manufacture of thread of what for the sake of convenience I may call "native cellulosic fibers", by which I mean natural unmercerized vegetable fibers such as cotton, linen, jute, ramie, etc., which still have substantially their native chemical composition and native crystal structure, except as that composition and structure may be affected by this invention. By the term "sewing thread" I refer to any thread or yarn or part thereof wherein the tensile strength of the thread is determined largely by the strength of the fibers rather than by the amount of friction tending to hold together the individual fibers.

Since the invention is of particular value in connection with cotton fibers, I shall assume in the following description that cotton is the material of the thread being treated.

In the practice of my invention, I first thoroughly saturate the thread, preferably with water, and then while the thread is thus saturated, I stretch it, preferably beyond its elastic limit but short of its breaking point. The stretching can be measured by the amount of elongation of the thread, and this elongation under the above stretching action is preferably greater than 50% of the maximum elongation which can occur in the thread without breaking. As a matter of fact, the stretching is preferably carried as near to the breaking point as practical without causing actual breaking.

I have found that after this wetting and stretching, the tensile strength of the thread per yarn size is greatly increased and, if desired, the thread, released from its stretching tension, may now be dried. However, since the thread has been stretched far beyond its elastic limit, it is preferable to subject it to a process of recovery, and this can be done by a second wetting treatment, which may also be done with water, when treating cotton thread. For example, subsequent wetting may take the form of boiling with water or bleaching according to well known bleaching practice until the thread has substantially reached a state of recovery.

I have discovered that by following the method just described above, the sewing properties of the thread are greatly improved. The improvements in the sewing properties to which I refer are an increased tensile strength, a uniformity of tensile strength for a wide range of humidity, a prevention of kinking, and a more compact structure and smoothness of yarn or thread.

Referring now to the drawings, and first to Fig. 1, the threads 1 may be passed under guides 2 in a tank 3 containing a suitable liquid 4 in which the threads are saturated, and then they are passed between a set of rollers 5 and thence to a second set of rollers 6, the rollers 5 rotating at a slower speed than the rollers 6 so as to stretch the thread at 7 therebetween, to the extent stated above.

After the thread has left the rollers 6, of course the stretching tension exerted by the rollers 5 and 6 is released, although it may still be under some tension if it is to be wound or possibly if it is to be handled in some other operation. However, the stretching tension is reduced to a very substantial amount. Then the thread may be, and preferably is, subjected to a second wetting operation. This operation may be performed by any suitable apparatus and in any suitable manner, the details of which may vary widely. After the second wetting, the thread may then be dried.

The liquid used for the second wetting operation is preferably of the same character as the liquid 4 and in any case is preferably not a weaker swelling agent than the liquid 4. When treating cotton, both of these liquids may conveniently be water, which is known as a relatively strong swelling agent, either in liquid or vapor form, although I may use other agents having the property of swelling native cellulose fibers without substantially changing their native structure. The liquid used should not materially change the chemical composition of the fibers, leaving them in substantially their native state. The temperature of the liquids may vary widely for different working conditions but is preferably room temperature or higher. Of course, when water vapor is used, the temperature will be much higher than that of a room. As a matter of convenience,

it is desirable to perform the initial wetting and stretching operations prior to bleaching or dyeing, in which case the bleaching or dyeing operation may be used also as the second wetting step of the process.

The result of the treatment described above is a thread which has greatly improved sewing qualities and in which those qualities are substantially uniform throughout a wide range of humidity. This is particularly true as to tensile strength. For example, I have found that, between 21° and 60° relative humidity, which may be considered as a normal range, the variation in strength with thread treated according to my invention is on the order of about 4% as compared with a variation on the order of 14% for the same range of relative humidity with thread not treated according to the invention.

Likewise, I have found that if the method described above is combined with a mercerizing treatment, the strength and luster of the thread both are greatly increased beyond what is obtained by mercerizing alone, although after mercerizing, the fibers are no longer in their native state. Preferably, the wetting and stretching are done before mercerizing.

Probably the correct explanation of the improved results is as follows:

The breaking load of sewing thread, which usually is made up of several single strands twisted together, is determined principally by the strength of the individual fibers of which the strands consist. These fibers, which it is assumed are native cellulosic fibers, are swollen by the first wetting operation described above and then the subsequent stretching of the swollen fibers results in what is known as plastic deformation of the fibers. This plastic deformation is caused by a rearrangement of the micellae of which the fibers consist. By this rearrangement the micellae of any one fiber acquire a greater parallelism to the axis of that fiber than before and the cohesion of the micellae or their attraction for each other is increased, resulting in an increase in fiber strength.

It is also possible that the methods described above may decrease the fiber slippage in some threads, thereby also increasing the strength of the thread.

Similarly, the plastic deformation results in an equalization or substantial uniformity of thread strength throughout the normal range of atmospheric humidity. This fact may be understood by considering the process of breaking thread, for example in a strength testing machine. When thread is thus broken, that breaking is accompanied and materially influenced by the plastic deformation of the fibers, because the atmospheric moisture acts as a swelling agent, loosening the forces of attraction between the micellae of the individual fibers and thereby decreasing the fiber strength. At the same time, however, the micellae of the swollen fibers become more freely movable and, under the stress applied in the testing machine, plastic deformation takes place, bringing the micellae of each fiber into a state of greater parallelism with respect to the fiber axis, thereby strengthening the fiber. As will be readily seen, these two phenomena counteract each other with regard to strength. The swelling in humid air causes a decrease of cohesion; whereas the rearrangement of the micellae improves that cohesion. Rayon, for instance, which has a highly pronounced tendency to swell in water shows a decrease of strength with increased atmospheric humidity; whereas cotton and other native fibers, which swell to a lesser degree, show increased fiber strength with increasing humidity.

For example, in a sewing thread made of cotton fibers, previously subjected to wet stretching according to this invention, the greater cohesion of the micellae caused by atmospheric humidity is essentially anticipated. Therefore, when a thread has been thus treated is subjected to a relatively high atmospheric humidity, that humidity is of little help in further increasing the strength of the thread. For example, if a thread of cotton fibers which has been previously wet stretched according to this invention is loaded up to the breaking point in a relatively high atmospheric humidity, this repetition of wet stretching does not help materially to change the structure of the individual fibers beyond what has already been accomplished. That is, the plastic deformation is substantially completed by treatment according to my invention. For the same reason dry air does not decrease the strength of yarn which has been wet stretched according to this invention, since the desired plastic deformation of the fibers has previously taken place.

However, thread of cotton fibers which has not been treated according to this invention shows considerably higher tensile strength when broken in humid atmosphere than when broken in relatively dry atmosphere, probably because breaking the thread in humid atmosphere results in the plastic deformation, as noted above.

Therefore a convenient test for thread, to determine whether or not it has been treated according to the invention, is to test it for its tensile strength and then submit it to a thorough wetting and subsequent stretching and then test it again for tensile strength. Sewing thread which has been treated according to my invention will show no apreciable increase in strength, whereas sewing thread which has not been so treated will now show a decided increase in strength, as will be seen from the examples given below.

The treatment may be carried on with the thread at various stages in its manufacture. Bleached thread is more easily penetrated by the water or other wetting agent and so it often is convenient to practice the invention with thread in that condition. When grey thread is used, preferably an appropriate wetting-out agent is employed to aid the swelling agent in entering the thread.

While I have shown in the drawing that the stretching is done in one step, nevertheless under some conditions it is found that better results are obtained by carrying on the stretching in successive steps.

While the above is believed to be an adequate disclosure of the invention, I shall give examples of treatments and the tests following those treatments. In these tests, the total strength of the thread in each instance was determined in the usual way, by multiplying the breaking strength of the thread by the yarn size thereof. The increase in strength caused by the treatment was measured by comparing the treated threads with identical threads which had not been so treated. It was found that the increase in total yarn or thread strength is only partly due to the increased fineness of the thread caused by the treatment, but is largely due to an actual increase in break-

ing strength of the thread caused by the treatment.

Examples

(1). Grey 6/cord cotton threads of different counts were saturated in water containing a known wetting-out agent to facilitate penetration of the water. The threads were then stretched between rollers to a point approaching the breaking point of the thread. The coarser counts of thread take a higher stretch than the finer counts. For example, 46 6/cord thread was run through the method continuously without breakage when given a stretch of 10.5% of its length. On the other hand, under similar conditions 7.5% was the limit of stretch given to 110 6/cord thread. After stretching, the thread was bleached and dried according to standard practice, in which of course the thread is released from the tension placed on it as described above, and the strength and size of the resulting threads were subsequently tested at 60° R. H. It was found that the total strengths of the threads had increased from 8% to 12%.

(2). Grey 36 2/cord thread was wet and stretched 6%, after which it was bleached and dried, the bleaching being used as the second wetting operation. It was found that the strength of the thread had increased 20% and its size had become 2.5% finer.

(3). Grey 60 3/cord thread was treated in the same manner as described in Example 2 except that it was stretched 6½%, after which it was bleached and dried, and it was found that its strength had increased 12% and its size had become 3.4% finer.

To show the relative uniformity of the tensile strength of the threads treated according to this invention, the following data were obtained from a test of a grey 46 6/cord thread which had been treated in the manner followed in Example 1, that is, it had been wet stretched approximately 10.5% and then bleached and dried. The thread was then tested at 60° R. H. and at 21° R. H., and in both instances the results were compared with similar tests on an untreated control sample. The results are given below, the size being measured in yards per pound, as known in the art.

Tensile strength of control sample at 60° humidity ____ pounds__	4.61
Tensile strength of stretched sample at 60° humidity ____ pounds__	4.79
Tensile strength of control sample at 21° humidity ____ pounds__	3.98
Tensile strength of stretched sample at 21° humidity ____ pounds__	4.58
Thread size of control sample ____	42.5
Thread size of stretched sample ____	45.1
Strength difference between stretched and unstretched thread measured at 60° humidity considering attenuation of thread per cent__	10
Strength difference between stretched and unstretched thread measured at 21° humidity considering attenuation of thread per cent__	22
Loss of thread strength of unstretched thread at 21° humidity ____ per cent__	13.7
Loss of thread strength of stretched thread at 21° humidity ____ per cent__	4.4

Referring now to Figs. 2 and 3, I have shown in Fig. 2 certain apparatus and other parts which are identical in function with those shown in Fig. 1 and which are identified by the same numerals and therefore will not be described further. In this figure, however, the threads, after leaving the rollers 6, are shown as being wound upon a beam 8 and this winding is preferably done under such a relatively high tension as to preserve the stretch just given to the thread between the rollers 5 and 6 or, in other words, to preserve or to set the plastic deformation which has been occasioned by the wet stretching through which the thread has just gone. Then the threads which are thus tightly wound on the beam are preferably subjected to a boiling, for example in water, after which they may be wound under relatively little tension on another beam 9, preferably passing through and being saturated by a liquid 10 in a tank 11 disposed between the two beams. In other words, the threads are wound tight on the beam 8 and slack on the beam 9. After passing through the liquid 10, the threads may be dried, either on the beam 9 or by any suitable drying apparatus (not shown), before winding on that beam.

All of the steps described above have been found to be valuable in improving the sewing qualities of the thread, although it is to be understood that various changes in the steps and in their order may be made and that certain steps may be omitted without departing from the invention as defined in the appended claims.

This application is a continuation in part of my copending applications, Ser. No. 129,307, filed March 6, 1937, and Ser. No. 210,567, filed May 28, 1938.

I claim:

1. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, then stretching the wet thread beyond its elastic limit and short of its breaking point, releasing the tension on the thread, and drying it in its condition of released tension.

2. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, then stretching the wet thread beyond its elastic limit and short of its breaking point, releasing the tension on the thread and wetting it again, and drying it in its condition of released tension.

3. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, stretching the wet thread beyond its elastic limit and short of its breaking point, winding it under tension, wetting it again, and winding it under relatively little tension.

4. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, stretching the wet thread beyond its elastic limit and short of its breaking point, winding it under tension, and unwinding and rewinding it under relatively little tension while wetting it a second time.

5. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, stretching the wet thread beyond its elastic limit and short of its breaking point, winding it under tension, wet-

ting it again, releasing the tension on the thread, and drying it in its condition of released tension.

6. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, stretching the wet thread beyond its elastic limit and short of its breaking point, winding it under tension, and wetting it again while thus tightly wound.

7. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, stretching the wet thread beyond its elastic limit and short of its breaking point, winding it under tension, and boiling it while thus tightly wound.

8. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, stretching the wet thread beyond its elastic limit and short of its breaking point, winding it under tension, boiling it while thus tightly wound, releasing the tension on the thread, wetting it again, and drying it.

9. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, stretching the wet thread beyond its elastic limit and short of its breaking point, winding it under tension, boiling it while thus tightly wound, and unwinding and rewinding it under relatively little tension while wetting it a second time, and finally drying it.

10. The method of treating sewing thread of native cellulosic fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, stretching the wet thread beyond its elastic limit and short of its breaking point, releasing the tension on the thread, and then mercerizing it in the usual way.

11. The method of treating sewing thread of cotton fibers which comprises thoroughly wetting the thread without substantially changing its chemical composition, then stretching the wet thread beyond its elastic limit and short of its breaking point, releasing the tension on the thread, and drying it in its condition of released tension.

12. A sewing thread containing native cellulosic fibers, and made in accordance with the method of claim 1.

13. A sewing thread containing cellulosic fibers, and made in accordance with the method of claim 10.

14. A sewing thread of native cellulosic fibers plastically deformed to rearrange the miscellae of the fibers so that the micellae of a fiber have a relatively greater parallelism to the axis of that fiber and have a greater cohesion than in the natural fiber, said thread having substantially the same tensile strength, after being wet and stretched, as it had before such wetting and stretching.

15. A sewing thread of native cellulosic fibers plastically deformed to rearrange the micellae of the fibers so that the micellae of a fiber have a relatively greater parallelism to the axis of that fiber and have a greater cohesion than in the natural fiber, said thread having less than the normal amount of kinkiness at normal twist and also having substantially uniform tensile strength over substantially the whole range of atmospheric humidity.

16. A sewing thread of native cellulosic fibers plastically deformed to rearrange the micellae of the fibers so that the micellae of a fiber have a relatively greater parallelism to the axis of that fiber and have a greater cohesion than in the natural fiber, said thread having substantially uniform tensile strength over substantially the whole normal range of atmospheric humidity.

17. A sewing thread of native cellulosic fibers plastically deformed to rearrange the micellae of the fibers so that the micellae of a fiber have a relatively greater parallelism to the axis of that fiber and have a greater cohesion than in the natural fiber, said thread having less than the normal amount of kinkiness at normal twist.

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