Oct. 25, 1949. A. E. WELCH 2,486,349

TWISTING MACHINERY

Filed Sept. 21, 1945

Fig. 1.

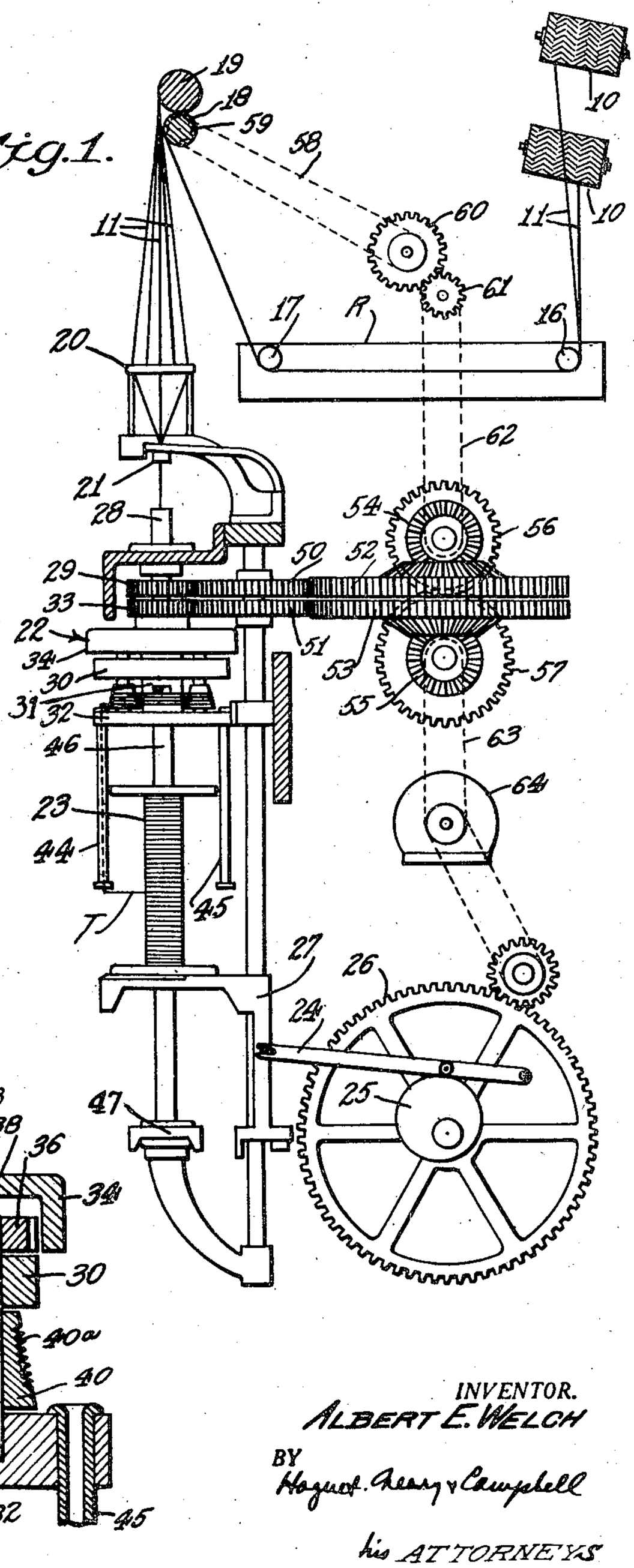
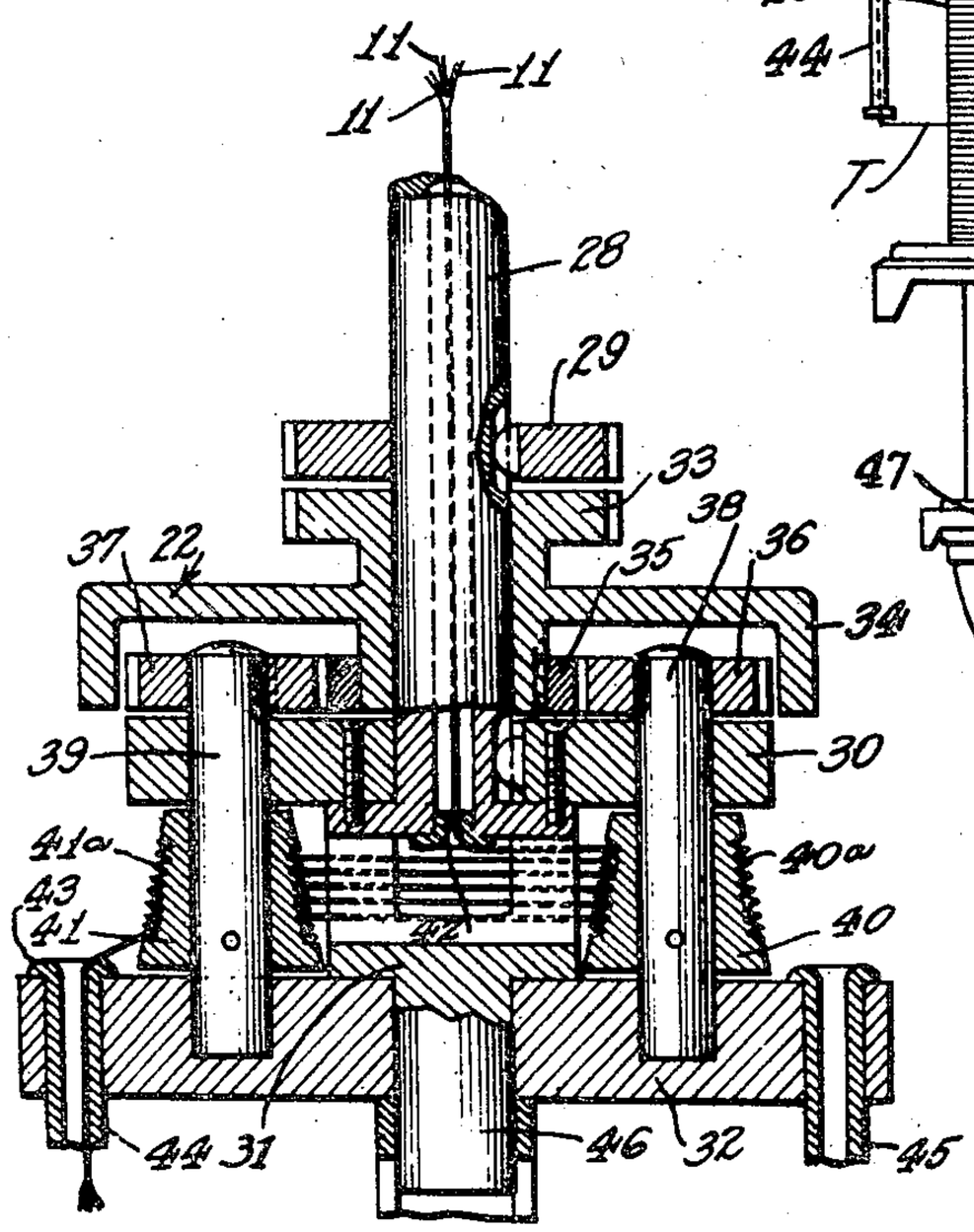



Fig. 2.

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Patented Oct. 25, 1949

2,486,349

# UNITED STATES PATENT OFFICE

2,486,349

## TWISTING MACHINERY

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Application September 21, 1945, Serial No. 617,726

5 Claims. (Cl. 57—55.5)

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This invention relates to improvements in methods of and devices for improving the tensile strength of threads, and it relates more particularly to improvements in methods of and devices for stretching and twisting multiple-ply threads, cords, twines and the like made of cellulosic fibers such as cotton, linen and cut artificial fibers, and to the threads, cords, twines and the like so produced.

The term "thread" will be used hereinafter to cover cords, twines, and the like, as well as threads.

It has been recognized for many years that the tensile strength of multiple-ply threads of either the core-containing or coreless type may be substantially increased by stretching the threads during their formation.

Many different devices and methods for stretching the twisted threads have been devised in the past. Apparently the conclusion has been reached by those skilled in the art that any further very considerable increase in tensile strength is not obtainable by stretching operations on machines as heretofore commonly constructed. Therefore, the tendency in recent years has been to use sizing materials on the threads to increase their tensile strength. Such sized threads have high tensile strength, and, when sizes are used in conjunction with stretching operations, very strong threads have been produced. However, the sizing materials that produce the best results are difficult to handle, inasmuch as they soil the machinery with sticky deposits and become gummy upon standing. The use of such sizing materials results in frequent shut-downs of the twisting machinery to permit removal of the deposits of sizing material and to clean the machinery.

I have discovered that it is possible to stretch the threads in a different manner than that suggested heretofore, and thereby obtain unsized threads having tensile strength as great as the strongest competitive sized threads made of comparable fibers. Therefore, by stretching the threads in accordance with the invention to be described herein, it is possible to do away with the size and obtain substantial economies in production. Or, if desired, it is possible, for example, to use a lower quality and less expensive fiber and still obtain threads having tensile strengths that are competitive with the threads produced of higher grade and more costly fibers by heretofore known methods and machinery. Inasmuch as high tensile strength threads, such as those used in the stitching of shoes, have usually been made of high quality, long fiber Egyptian cotton, it will be understood that a substantial saving in the cost of the manufacture of such threads is obtained by the use of my method and apparatus, for the reason that they make it possible to use domestic grades of cotton fibers to produce threads with as great tensile strengths as those normally made from the more costly imported fibers.

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Generally, the invention consists of precisely and uniformly stretching the individual plies or strands prior to the conventional twisting operation which twists the ply strands into a multiple-ply thread and after the twisting operation stretching the thread in the usual well known manner on tapered grooved whirls or capstans.

More particularly, the individual plies or strands are stretched as the first step of an uninterrupted sequence of stretching, condensing, twisting, and final stretching so as to obtain, or make possible, a total elongation greater than that heretofore obtained with heretofore known conventional methods and machinery. By stretching the plies and the twisted thread in two separate but successive operations, apparently the disposition of the fibers in the finished thread is so adjusted and improved that, when subjected to tension, the strain is more uniformly distributed among all the plies and their fibers and the overall strength of the composite thread is markedly increased. Moreover, the sequential stretching operations do not increase the breakage of the thread during the process, as would a corresponding increase in the single stretching operation of the conventional method, and thus shut-downs of the twisting machinery for piecing broken ends are infrequent. If desired, such threads may be treated with a suitable sizing material, with the result that super strength threads can be produced that far exceed the strength of the same gauge, sized threads heretofore produced. Also, by constructing the thread of long staple fibers, e. g. Egyptian cotton, and treating it with sizing, and stretching it by my method, a thread of still greater strength can be produced.

For a better understanding of the present invention, reference may be had to the accompanying drawings in which:

Figure 1 illustrates diagrammatically a typical form of device for twisting and stretching the thread in accordance with the present invention, and

Figure 2 is a view in vertical section and partly

broken away of a well known typical form of twisting head utilized in the device.

As illustrated particularly in Figure 1, the twisting and stretching mechanism may include elements of conventional type. The arrangement of the elements individually is generally the same as that of this and other kinds of twisting devices used heretofore. The illustrated combination of these elements is unique.

A typical device may include a plurality of packages 10 for supplying a plurality of strands or plies of yarn 11 to suitably grooved rollers 16 and 17 which are disposed in a receptacle R for receiving water or sizing material, as desired. The plies 11 are passed from beneath the roller 17 upwardly between a pair of positively driven feed rolls 18 and 19, to be described later in greater detail, through a conventional spreader 20 and thence through a condenser 21 to a twisting head or flyer 22 generally of the type disclosed in the Brownell Patent No. 277,986, dated May 2, 1883. The twisting head 22 twists the plies 11 into a multiple-ply twisted thread T, stretches the thread T and delivers it to a bobbin 23. The bobbin 23 may be reciprocated relatively to the twisting head by any suitable conventional mechanism, for example, by means of a lever 24 that is oscillated by means of a cam 25 carried on, or driven by, a gear 26. The lever 24 may engage a vertically reciprocable carriage 27 that supports the bobbin 23. Other known types of bobbin-reciprocating mechanisms may be used, inasmuch as the structure generally is conventional.

The twisting head 22, as indicated above, may be of well known type. As illustrated, it includes a hollow spindle 28 which is provided with a gear 29 at about its midportion and has its lower end fixed to a top cross plate 30 of a yoke comprised of parts 30, 31 and 32. The spindle 28 also carries a gear 33 which is rigidly attached through cover plate 34 to a gear 35 for rotation relatively to the cross plate 30 and which meshes with a pair of planet gears 36 and 37. The gears 36 and 37 are fixed respectively to the shafts 38 and 39 which are jouralled in the bottom cross member 32 and in the top cross plate 30 for rotation relatively thereto. The shafts 38 and 39 are fixed to tapered capstans 40 and 41 which are provided with suitable graduated circumferential grooves 40*a* and 41*a* respectively for receiving the thread.

In operation, the several plies of yarn 11, 11, etc. are introduced through the spindle 28 and through a rounded guide member 42 to one of the capstans, for example, capstan 40. The thread is wound around and around the graduated grooves in the capstans 40 and 41 and is taken off to a thread guide 43 at the top of either of the winding arms 44 or 45 and thence to the bobbin 23. The bobbin is retained in proper position relatively to the twisting head 22 by means of a spindle 46 which projects downwardly from the cross member 32 and fits loosely within the bobbin, and in the step bearing 47.

As is known in the art, when the two gears 29 and 33 are driven at different speeds, for example, by means of idler gears 50, 51, the drive gears 52 and 53, the bevel gears 54 and 55, and change gears or twist gears 56 and 57, the twisting head will rotate, thereby twisting the threads together and at the same time the capstans 40 and 41 will rotate relatively to the twisting head, thus advancing the thread a measured distance through the spindle 28, this distance being dependent upon the selected ratio of gears 56 and 57. Inasmuch as the capstans 40 and 41 are tapered and provided with graduated grooves, the thread is stretched as it passes around them from the small ends to the large ends, and thereby is elongated a definite percentage, depending upon the taper of the capstans 40 and 41. In a typical example, the taper of the capstans 40 and 41 may be such as to stretch the thread about 6.4%. Although this amount of stretch may be varied considerably if desired, by using capstans having more or less taper, a limit of only slightly more than 6.4% generally cannot be exceeded without causing internal breakage of individual strands—technically known to those skilled in the art as "cut ends."



The above described mechanism stretches the multiple-ply thread after the plies are twisted together. As indicated above, such stretching is insufficient to provide the greatest tensile strength. Additional tensile strength can be obtained by stretching the individual thread plies 11 before introducing them into the twisting head 22. This can be accomplished by the present invention.

The novel feature of the apparatus, disclosed in Figure 1, for obtaining this result, is the relationship between the rolls 18 and 19 and the twisting head 22. The roll 18 together with its contact driven weight-roll 19 must be positively driven, for example, by means of a chain 58 and sprocket 59, change-gears 60 and 61, and other suitable power transmitting devices 62 and 63 connected to the gears 54 and 55 that drive the twisting head 22. These gears may be driven by means of a motor 64 that is also suitably connected to the gear 26 for reciprocating bobbin 23. In order to obtain the best results, the speed relationship between the roller 18 and the capstans 40 and 41 in the twisting head 22 is made such as to impart between 2% and 3½% stretch to the plies before and as they enter the twisting head 22, depending upon the character or quality of the fibers being used. This may be done by variation of the ratios of the gears 60 and 61.

As shown by tests of the tensile strength of threads such as shoe thread, with standard testing equipment, best results are obtained when the individual thread plies 11 are stretched between about 2% and 3½% and the combined stretch in the plies and in the twisted thread is between about 8½% and 10%. A particularly strong thread having about 10% greater tensile strength than the same thread when stretched only in the twisted state may be produced by stretching the individual plies 11 of certain kinds of cotton about 2.9% and stretching the twisted thread an additional 6.4%. Ordinarily, the threads produced heretofore are stretched in the twisted state about 6.4%.

From the preceding description, it will be apparent that the improved results arise because of the several stretching operations which stretch not only the twisted thread but also the thread plies prior to twisting.

It will be understood, of course, that devices other than the device illustrated may be used for accomplishing the multi-stage stretching of the plies and the composite threads and that the percentage of stretch may be varied substantially without departing from the invention. Therefore, the device and the typical method described above should be considered as illustrative of the preferred forms of methods and

devices embodying the invention and not as limiting the scope of the following claims.

I claim:

1. A method of increasing the tensile strength of multiple-ply twisted thread, which comprises stretching separate thread plies equally by positively advancing said plies at the same predetermined speed to a twisting device, twisting and advancing said plies equally at a higher speed in the twisting device than the speed at which the plies are advanced to the twisting device, to form a multiple-ply twisted thread and further stretching said multiple-ply thread to provide a total stretch of between about 8½% and 10%, the amount of stretching of said separate plies being between about 2% and 3½%.

2. A device for twisting and increasing the tensile strength of multiple-ply twisted threads, which comprises a rotary twisting head having rotary, tapered capstans for stretching a twisted thread, a feeding roller for engaging a plurality of thread plies and supplying them to said twisting head, a weighted roller for pressing said plies against said feeding roller, said plies passing partially around and between said rollers, and power transmitting means connected to said twisting head and said feeding roller for rotating said head, said capstans and said feeding roller, said power transmitting means driving said head and said capstans at a speed sufficient to stretch said thread plies before they are twisted by said twisting head.

3. In a thread twisting and stretching device, the combination of a rotary twisting head for twisting thread plies into a multiple-ply twisted thread, said head having tapered rotary capstans with graduated grooves for stretching said twisted thread, a feed roller for supplying and controlling the delivery of a plurality of separate thread plies to said twisting head, and power transmitting means connecting said twisting head, said capstans and said feed roller for driving them in timed relation to stretch said thread plies equally



prior to twisting and to stretch said thread a predetermined amount while passing over said capstans.

4. A method of increasing the tensile strength of multiple-ply twisted threads which comprises twisting together and simultaneously advancing a plurality of thread plies to form a thread, positively advancing all of said plies to be twisted at the same speed, said speed being less than the speed at which the plies are advanced during twisting to stretch all of said plies equally and uniformly, the difference in the speeds at which the plies are positively advanced and advanced during twisting being sufficient to stretch said plies equally between about 2% and 3½%, and thereafter stretching the thread not more than about 6.4%.

5. A textile thread having high tensile strength made in accordance with the process of claim 4.

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