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METHOD AND APPARATUS FOR STORING AND ADVANCING THREAD

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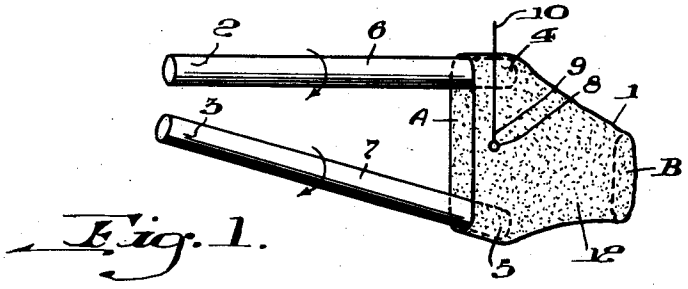


Fig. 1.

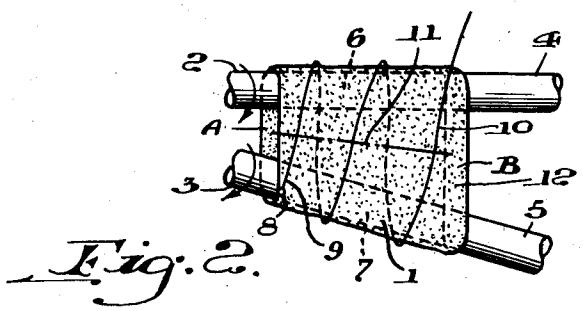


Fig. 2.

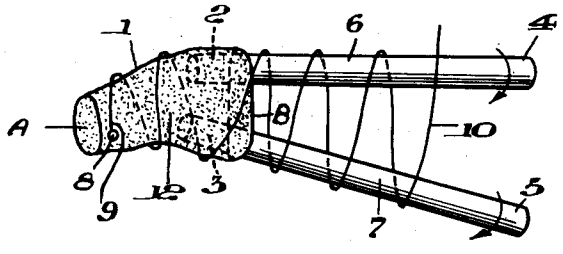


Fig. 3.

INVENTOR.
GAETANO F. D'ALELIO.

BY Robert Knox Jr.

his ATTORNEY.

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METHOD AND APPARATUS FOR STORING AND ADVANCING THREAD

Gaetano F. D'Alelio, Pittsburgh, Pa., assignor to Koppers Company, Inc., a corporation of Delaware

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This invention relates to processes and apparatus for spinning and treating artificial threads in a continuous manner, and in particular, to such processes and apparatus in which the thread from the spinneret is stored and advanced along a helically looped path around, along and by means of a pair of inclined rotating rollers, during which advancement, the thread may be coagulated, washed, desulfurized, toughened, dried or treated in any manner desired.

This invention more specifically relates to an improved process and apparatus for initially establishing the above helically looped path of thread around and along the supporting rollers at the commencement of spinning or after a break in the thread, by means of a flexible sleeve or stocking.

Usually, in such two roller processes the rollers are mounted on shafts which may be adjusted to any desired inclination to each other. The rollers may be supported at one end only, with or without their free ends connected with a rigid, adjustable bar to prevent changes in roller inclinations, or they may be supported at both ends. Both of the canted rollers are rotatable. One or both of the rollers may be rotated by an external driving means.

To start such thread-advancing apparatus, either initially or after a break in the thread, the free or broken end of the thread is led by hand through a guide, over, around and axially along the pair of rollers to establish the helical thread path, and then through a second guide to either another thread advancing reel or to a thread collector.

In order to so establish the helical path manually around the rollers, all parts of the machine must be hand accessible with resultant wasted space. Furthermore, the necessary handling of the thread is rendered difficult due to the extreme delicateness of the thread.

To eliminate this wasted space, a narrow endless flexible belt or rope or loop has been previously proposed which passes, when stretched, completely around the pair of canted rollers. To start the reel, either initially or after a break, the flexible rope is placed around the pair of rollers at the widely-spaced, thread-receiving ends. The broken or new end of artificial thread coming from the spinneret in the coagulating

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bath is attached or tied by hand to the rope. Upon release of the thread and rope, said rope moves around and axially along the pair of canted rollers carrying the thread with it.

When the belt finally moves off the closely-spaced ends of the canted rollers, the helical path of the thread over the rollers has been established. The thread is then detached from the rope and passed through guide hooks to another reel or a collecting device.

However, though the endless flexible rope removes the necessity of wasted space around the reel for hand access thereto, its use presents the following difficulties.

First, the delicate end of the thread or the "clot" of coagulated material accumulating near the spinneret in the coagulating bath has to be tied or knotted to, or wound around the rope or belt by hand, resulting in frequent breakage of the fragile thread. Since the thread, as it is first extruded, is only partially coagulated and therefore very weak, it is easily broken by such handling. Furthermore, the tying or knotting of the rope by hand is time consuming and necessitates manual accessibility to the thread-receiving portion of the rollers.

Second, the single point on the thread at the knot or attachment of the thread to the rope tends to break when the rope is released. This is probably due to the sudden, external pull of the accelerating rope as said rope starts to move around the rollers. Furthermore, the fiber making up part of the knot or tie acts as a fulcrum for this point on the string with a resultant uneven distribution of the total pull over the cross sectional area of the thread at this point. Therefore, only a small portion of this cross sectional area of the thread is subjected to the greatest part of the pull with consequent breakage. If the thread is wound around the rope to attach it thereto, rather than knotted or tied, the rope itself acts as a fulcrum.

The tendency of the thread to break at this point may be likened to the tendency of a string to break if looped around the finger so that one part of the string or the finger acts as a fulcrum for another portion when the breaking force or pull is applied.

Third, the tendency of the thread to break is enhanced during its initial helical path around

and along the rollers. Perhaps this is due to the fact that during this initial path, the thread is continuously subjected to the uneven, newly applied, frictional force of each rotating roller surface as said thread initially contacts said surface. As the thread first contacts each roller surface and becomes frictionally attached thereto, said surface frictionally asserts a new force upon the delicate thread. It is during the assertion of this new frictional force that the delicate thread is subject to the greatest stress. However, once the initial helical path is established, the frictional forces of all the rotating roller surfaces is uniform and equally distributed over the total length of thread along the path.

Fourth, on breakage of the thread which, when a flexible rope is utilized, is more likely during the establishment of the initial helical path for the reasons given above, the broken end of said thread wraps itself around one of the single rollers necessitating the cutting away or unwinding of the wrapped thread by hand.

Fifth, the thread, at times, during its initial path over the rollers may become slack and consequently collects in a bunch or wad on one of the rollers and becomes wrapped therearound. This wrapped thread exerts a force counter to the force exerted by the flexible rope thereby resulting in thread breakage.

The insufficiency and disadvantages of a flexible moving rope were recognized by Barker in U. S. Patent 2,545,015. In this patent a method is disclosed of establishing the initial helical thread path without the use of a longitudinally moving rope or belt.

This is done by attaching the thread end to an endless belt or rope of flexible material encircling the thread-receiving ends of the rollers at which point it is permanently maintained by engagement with circumferential grooves in the rollers. The thread is pulled over the belt by the rotation thereof, and wraps itself therearound to form a wrap or wad of superimposed loops of thread over the rope or belt. Finally the wrap or wad of thread is released by manually rolling it out of the grooves onto the surfaces of the rollers. The wrap or wad then rotates about and moves longitudinally along the rollers pulling the thread along with it to establish an initial helical thread path around the rollers.

The present invention overcomes these disadvantages in a different manner by providing a novel process and apparatus for initially establishing the helically-looped thread path around rotating, inclined rollers with a minimum manual handling of said thread, with a minimum thread breakage and without wrapping of broken thread ends around the individual rollers in cases of thread breakage.

More specifically, these disadvantages are overcome by stretching at least an end portion of a flexible sleeve or stocking over and about the starting, widely-spaced ends of the rollers in a tautly embracing, flexible sleeve friction-driving relationship therewith, allowing the rotation and inclination of the rollers to rotate and longitudinally move the entire sleeve onto the rollers, around and axially along the rollers and finally off the other end of the rollers, adhesively contacting a free or broken thread end with an outside surface portion of the sleeve as said portion moves past the thread-receiving section of the rollers, allowing the thread to be drawn or wrapped by the rotating and longitudinally

moving sleeve along a helically-looped path first around or about and in contact relationship with the outside surface of the flexible sleeve as the sleeve rotates around and travels the length of the rollers and thereafter around and in contact relationship with the thread contacting portion of the rollers as the sleeve is driven off the other end of the rollers, and thereafter detaching the thread from the sleeve.

The accompanying drawings show a certain form and manner in which the invention may be embodied and practiced but the invention is not limited to such illustrative instance.

Fig. 1 is a view of the artificial thread-advancing reel and flexible sleeve utilized in the practice of the present invention, wherein the sleeve is first applied to the rollers.

Fig. 2 is the same view wherein the sleeve has travelled axially along the rollers until all of said sleeve is stretched around the rollers.

Fig. 3 is the same view wherein the sleeve has almost wholly worked itself off the ends of the rollers and the helical thread path over the rollers has been established.

The present invention is carried out on a typical inclined, rotating, two-roller type thread-advancing reel by stretching at least an end portion of a flexible sleeve or stocking over and around the starting, widely-spaced end portions of the two rotating, inclined rollers in such a tautly embracing, flexible sleeve friction-driving relationship therewith, that the rotation and inclination of the rotating rollers drives the entire flexible sleeve around and axially along the length of, and finally off the other more closely-spaced ends of the rollers. During the rotational and longitudinal movement of the sleeve around and along the rollers, the starting end or broken end of the thread is adhesively contacted or attached to an outside surface portion of the flexible sleeve as this sleeve portion passes the thread-receiving section of the rollers.

Since the thread is generally wet, it adheres to the surface of the sleeve on contact therewith forming an adhesive attachment thereto, and is driven with the flexible sleeve around and axially along the length of the rollers and finally off the closely-spaced ends of the rollers thereby drawing or wrapping the thread along a helically looped path, first around and in adhesive contact relationship with the outside surface of the flexible sleeve as the sleeve rotates around and travels the length of the rollers, and thereafter around and in contact relationship with the thread-covering portion of the rollers as the sleeve is driven off the other more closely spaced ends thereof.

After the sleeve has worked itself entirely off the more closely spaced ends of the rolls, the thread is detached therefrom and is passed through a guide to either another thread-advancing reel or to a thread collector. The flexible sleeve is of such dimensions as to pass, when stretched, completely around from about one half to about the whole of the total thread-covering portion of the rollers in a tautly embracing relationship therewith. The inside diameter of the sleeve is such that it fits snugly and tautly around the two rollers in a stretched condition during its entire longitudinal travel from the widely-spaced ends of the rollers to the closely-spaced ends. It is this taut, snug fitting over the rotating rollers which provides sufficient friction between the inside surfaces of the sleeve and the outside working surfaces of the rollers to allow

the rotating rollers to rotate the sleeve and the thread attached thereto about both rollers. The inclination of the rollers toward each other causes the rotating sleeve and the thread attached thereto to move longitudinally along the rollers.

By utilizing the flexible sleeve of the present invention, the free end of the thread need not be attached, tied or knotted by hand, as is necessary with the prior art flexible rope. Therefore the excessive and tedious handling of the delicate thread, required in utilizing the prior art flexible rope, with resulting breakage and necessary hand accessibility to the thread-receiving portion of the rollers, is not necessary in the present process and apparatus.

According to this invention the wet end portion of the thread is merely dropped on or allowed to come into contact with the outside surface of the moving sleeve to which it adheres and becomes adhesively attached. As the thread is pulled over the rotating and longitudinally moving sleeve, every portion of the wet thread consequently wrapping itself around the sleeve, adheres thereto and is supported thereby.

The rotational and longitudinal pull of the sleeve on the thread during the greatest part of the thread's initial movement from one end of the rollers to the other is distributed over the length of thread wrapped about and adhesively attached to the outside surface of the sleeve, resulting in a small external force per unit area of thread and less thread breakage.

In using the elastic rope of the prior art, as the advancing thread contacts various portions of the outside surface of each roller for the first time, it becomes frictionally attached thereto and thus suddenly subjected to the rotational pull thereof. It is believed that these sudden, newly applied forces or pulls cause the thread to break. However, once a substantial portion of the helical path is established, the frictional pull of the rollers' surfaces on the thread is uniform and constant with less chances for breakage. The sleeve serves to support the thread during the establishment of the initial helical path when breakage is more likely until the path is established and breakage is less likely.

According to the present invention, no fulcrum action is applied to the thread with consequent unequal stress over its cross sectional area. There is no one point on the thread which is subject to the entire external pull of the sleeve. The frictional pull of the outside surfaces of the sleeve is uniform and constant at all times. There is no sudden external force applied to the thread when utilizing the sleeve of the present invention, whereas in the prior art flexible rope process the suddenly applied external pull of the rope on the thread when said rope is released causes breakage.

According to the present process the thread does not frictionally contact the roller surfaces until the initial helical path is established, after which the path is gradually transferred from the sleeve to the roller surfaces, whereas in the prior art flexible rope method the thread frictionally contacts the roller surfaces during the establishment of its initial helical path. This difference between the present process and that of the prior art greatly reduces thread breakage.

Furthermore, the sleeve prevents the broken end of thread from wrapping itself around the individual rollers in case of thread breakage during the establishment of the initial helical path when breakage is ordinarily more likely to

occur. In such cases the broken end merely adheres to the sleeve and continues around and axially along the rollers to establish the initial helical path.

If the thread becomes slack and consequently bunched on the sleeve during the establishment of the initial thread path, the thread bunch continues to pass along and around the rollers with the flexible sleeve.

A preferred method of and apparatus for practicing the present improved process is now described with reference to the accompanying drawings. One end A of an elastic sleeve 1 is stretched tightly over the widely-spaced starting ends 4 and 5 of two rotating inclined rollers 6 and 7 of a typical inclined rotating two-roller type thread-storing and thread-advancing reel. The frictional contact between the inside surface of the sleeve and the outside surfaces of the rotating rollers allows the rotating rollers to rotate the sleeve around the rollers. The inclination of the rollers causes the rotating sleeve to move longitudinally along the rollers toward the closely-spaced ends 2 and 3. As a portion 8 of the outside surface of the rotating and longitudinally moving sleeve passes the thread-receiving section of the rollers, the starting or broken end or "glob" 9 of a wet synthetic fiber 10 is contacted with portion 8 of the sleeve, and by adhesion thereto is carried along with portion 8 around and axially along the rollers until the total length AB of the sleeve 1 is stretched over the thread contacting portion of the roller as in Fig. 2. As the end of the thread 9 is carried with the sleeve about and along the rollers the wet thread is pulled and wrapped around the outside surface of the sleeve, following a helical path as shown in Fig. 2. Every portion of the wet thread wrapped around the sleeve adheres to and is supported by the sleeve. As the sleeve and the thread move longitudinally over the rollers past the thread-contacting portion thereof and finally off the closely-spaced ends 2 and 3 of the rollers, the helical thread path is gradually transferred from the sleeve to the roller surfaces, and is established about and in contact relationship with the working surfaces of the rollers as shown in Fig. 3. After the sleeve moves off the closely spaced ends of the rollers, the thread is detached therefrom by cutting and the cut end of the thread is led through a guide (not shown) to another thread-advancing reel or a thread collector. The dimensions of the sleeve are such that it passes when stretched completely around the whole of the thread-contacting portion of the rollers in a tautly embracing relationship therewith. The sleeve is made up of a rectangular piece of flexible material which has two opposite edges joined together by separable or inseparable connections at 11. The sleeve may also be provided with a coating 12, which assists the thread in adhering to the sleeve.

It is not intended that the invention should be limited in scope to the illustrative instance. For example, the sleeve may be of any dimension which will allow it, when stretched, to pass completely around from about one half to about the whole of the total thread contacting portion of the rollers in a tautly embracing relationship therewith. The sleeve may be of such length as to stretch completely over the total working surfaces of the roller, or longer. It should cover at least about one half of the thread contacting portion of the roller, but may be shorter where the thread contacting portion of the rollers is long.

The sleeve may be of ordinary rubber or any rubber-like material which can be stretched, and which, when stretched and thereafter released, will return to its normal shape.

Elastic woven fabric, rubberized fibers, synthetic and natural rubber may be utilized. Coiled springs or metal fibers or filaments in any stretchable or resilient form are satisfactory. However, material which will be adversely affected by the treatment liquids to which the thread is subjected should not be used.

The method of the invention may be applied to any rotating, inclined, roller-type thread-advancing reel, but is particularly useful in the two-roller type of thread-advancing reels utilized in the spinning of artificial threads.

To increase the adhesion of the thread to the sleeve, the outside surface of the sleeve may be covered with a sticky material which will not react with the flexible material of the sleeve, the treatment liquor to which the thread is subjected or with the fiber itself, e. g. rubber cement, oils, lubricants, viscous liquids, etc.

Flexible sleeves may be utilized having surfaces covered with bristle, brush or any irregular protrusions which aid in adhesion of the thread to the sleeve surface. However, surfaces having cutting edges are not satisfactory.

The sleeve may be inserted about the rolls either by pulling one of its ends over the more widely-spaced starting ends of the rollers as far as desired along the rollers and allowing the rotation of the rollers to pull the remaining portion of the sleeve onto and along the rollers, or an end of the sleeve may be spaced over the closely-spaced ends of the rollers and manually pulled axially about the rollers to whatever position is desired along the rollers.

If the latter method is used with rollers having their closely-spaced ends free, the sleeve may be integral. Otherwise, it must be formed by detachably connecting two opposite edges of a rectangular piece of flexible material by any well-known connection means such as a zipper or snaps.

If the thread inlet to the thread-receiving portion of the rollers is maintained above the rollers and directly over the thread-receiving portion thereof, the thread end may be merely allowed to drop onto the moving sleeve in order to initiate the helical thread path. A stationary knife may be positioned adjacent to the closely-spaced ends of the rollers, so placed that the thread will be cut and automatically detached from the sleeve, as the sleeve moves off the rollers.

Although an attempt has been made to explain the plausible theoretical basis for the decreased thread breakage in utilizing the present invention, the invention should not be limited to such theory.

It will be obvious to those skilled in the art that various modifications can be made in the several parts of the present apparatus and the several steps of the present process in addition to those enumerated hereinabove without departing from the spirit of the present invention and it is intended to cover in the claims such modifications as are included within the scope thereof.

I claim:

1. In a process for treating artificial thread by storing and advancing said thread in a helically looped path around, axially along and by means of the rotation and inclination of a pair of rotating, inclined rollers, the improvement of initially establishing said helical path of thread around said rollers comprising: stretching at least an end portion of a flexible sleeve around the starting end portions of said rotating inclined rollers in a tautly embracing, flexible sleeve friction-driving relationship therewith to initiate the driving of the flexible sleeve around and axially along the length of said rotating rollers by means of the rotation and inclination of said rollers; said flexible sleeve being of such dimensions as to pass, when stretched, completely around from about one half to about the whole of the total thread-contacting portion of the rollers in a tautly embracing, flexible sleeve friction-driving relationship therewith; attaching a starting end of thread to an outside surface portion of said flexible sleeve as said portion passes the thread-receiving section of the rollers; driving said flexible sleeve and the end of the thread attached thereto around, axially along the length of, off the other ends of and by means of said rotating, inclined rollers to draw the thread along a helically looped path, first around and in contact relationship with the outside surface of said flexible sleeve as said sleeve rotates around and travels the length of the rollers, and thereafter around and in contact relationship with the thread-contacting portion of said rollers and said sleeve is driven off the other ends of said rollers; and thereafter detaching the thread from said sleeve.

2. The process of claim 1, wherein the starting end of the thread is attached to said portion of the outside of said flexible sleeve, by adhesively contacting said starting end with said portion.

3. Apparatus for storing and advancing thread comprising: a pair of rotatable inclined rollers for storing and advancing said thread in a helically looped path around and axially along said rollers; a flexible sleeve tautly embracing said pair of rollers in flexible sleeve friction-driving relationship therewith: said flexible sleeve being of such dimensions as to pass, when stretched, completely around from about one half to about the whole of the total thread-contacting portion of the rollers in a tautly embracing, flexible sleeve friction-driving relationship therewith.

4. The apparatus of claim 3 wherein the flexible sleeve is elastic.

5. Apparatus for storing and advancing thread comprising: a pair of rotatable inclined rollers for storing and advancing said thread in a helically looped path around and axially along said rollers; a flexible sleeve tautly embracing said pair of rollers in flexible sleeve friction-driving relationship therewith; said flexible sleeve being of such dimensions as to pass, when stretched, completely around from about one half to about the whole of the total thread -contacting portion of the rollers in a tautly embracing, flexible sleeve friction-driving relationship therewith; said flexible sleeve being adapted to be driven around, axially along the entire length of and finally off the closely positioned ends of said rotatable inclined rollers by means of the rotation and inclination of said rollers; said flexible sleeve having an end portion which is adapted to be stretched around the starting widely-spaced ends of said rotating inclined rollers in a tautly embracing, flexible sleeve-driving relationship therewith to initiate the movement of the flexible sleeve around and axially along said rotating rollers; said flexible sleeve further being adapted to have attached to a portion thereof a starting end of said thread as said portion moves axially past the thread-receiving section of said rollers,

whereby the said flexible sleeve and the end of the thread attached thereto are driven around, axially along the length of and off the closely positioned ends of said inclined, rotatable rollers by means of the rotation and inclination of said rollers to draw the thread along a helically looped path first around and in contact relationship with the outside surface of said flexible sleeve as said sleeve rotates around and travels the length of said rollers, and thereafter around and in contact relationship with the thread-contacting portion of said rollers as said sleeve is driven off the other ends of said rollers.

6. The apparatus defined in claim 5 wherein a flexible elastic sleeve is utilized having an adhesive coating to which the starting end of the thread will adhere upon contact therewith.

GAETANO F. D'ALELIO.

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