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 DEVICE FOR TWISTING YARN

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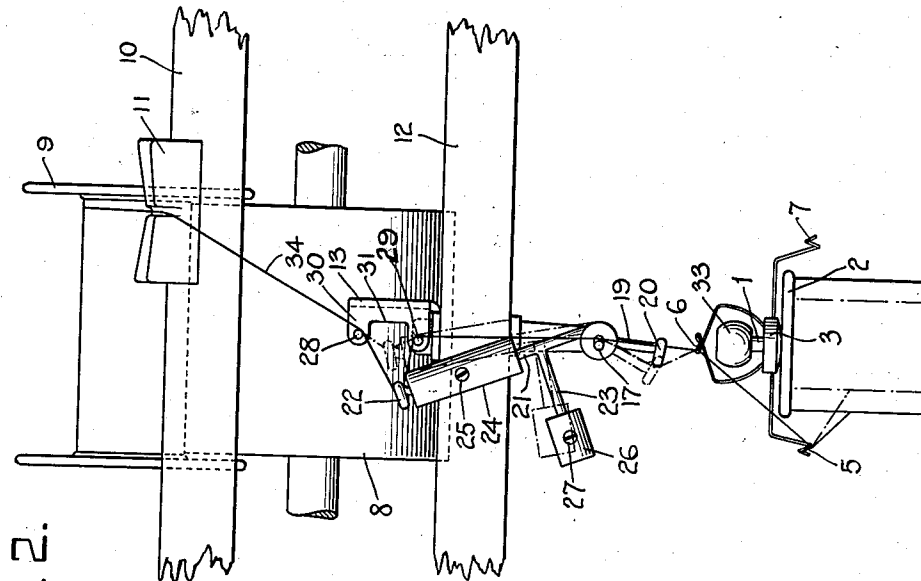


Fig. 2.

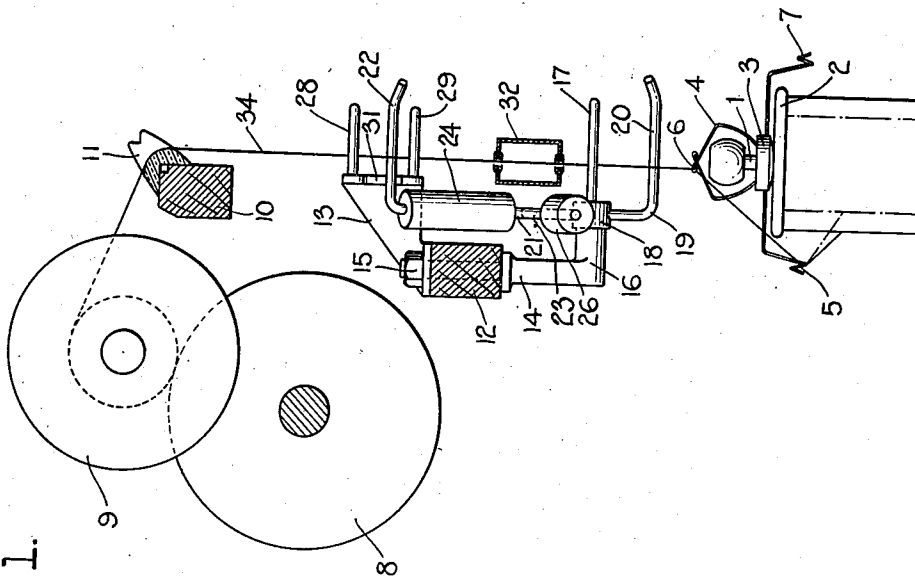


Fig. 1.

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DEVICE FOR TWISTING YARN

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This invention relates to the method of and device for twisting yarns or threads and relates more particularly to the production of yarns or threads of high twist suitable for forming crepe fabrics and of relatively fine denier or of low tenacity by means of a flyer or analogous twisting device.

An object of the invention is to twist yarns to a substantially high degree of twist in a very economical and efficient manner to produce the optimum creping of fabric formed from same. Another object of the invention is to twist yarns while treating the same in such a manner that the resulting yarn is uniform in compactness, degree of treatment and degree of twist. Another object of the invention is to provide means for employing a flyer twisting device to impart high twist to yarns of fine denier and/or low tenacity. A still further object of the invention is to provide means for employing a flyer twisting device to impart twist to yarns wherein an even tension is applied to the yarn during the twisting regardless of the depth of yarn on the supply bobbin yet maintaining a substantial length of the yarn travelling in a constant path. Other objects of the invention will appear from the following detailed description.

In the drawing wherein like reference numerals refer to the same or similar elements in the respective views:

Fig. 1 is a side elevation of a part of the device, partially in section, constructed according to this invention.

Fig. 2 is a front elevation of a part, or one segment of a device, constructed according to this invention and corresponds to the elements in the side elevation shown in Fig. 1.

When attempts were made to insert a large number of twists per inch in yarns made of artificial filaments and particularly yarns of fine denier by means of a flyer twister, it was found that the yarns tend to break or be damaged. This causes so many interruptions in the operations and necessitates so much supervision that the twisting operation by means of a flyer cannot be carried out with complete commercial success. I have found that this is due to the fact that in previous apparatus for flyer twisting a maximum and uniform amount of tension could not be applied by the ordinary type of stationary guide eyes for guiding the yarn leaving the flyer and travelling toward the take-up device. It was seen that there was need of some kind of tension regulator arising from the fact that when twisting with the use of the ordinary flyer, great variations

in tension occurred in the thread while it is undergoing the actual process of twisting. It was also observed that the tension on the twisting yarn increases considerably as the supply bobbin empties. It was also found that when, in the course of twisting, the thread was drawn from the top of the bobbin, the tension was lighter than when it was drawn from the bottom of the bobbin. These causes, taken together, result in a very great difference in tension so that in the ordinary course of twisting the highest tension normally obtained may be two, three or four times as high as the lowest tension and even greater extremes than this are possible.

It was found in the twisting of crepe threads that the tension on the thread or yarn between the flyer and the take-up bobbin, that is, at that part of the yarn where the twist is actually being inserted, affects considerably the characteristics of the resulting yarn in its creping property. Thus, if the tension on the yarn during twisting is too light the thread will not crepe so highly, but if the tension on the yarn at this point is sufficiently heavy the maximum crepe may be obtained. As a rule, it was found best to use a tension as heavy as the yarn will bear without breaking more than ordinarily during the twisting process. It was further found that the amount of tension employed at that part of the yarn where twist is being inserted considerably affects the character of the yarn in respect to its compactness. For instance, the higher the tension, the more compact and uniform will be the diameter of the yarn, while if the tension is loose, the filaments are not compacted tightly together although there may be inserted in the yarn the same number of turns per inch and this gives rise to ununiform creping properties.

By employing this invention, that is, by automatically regulating the tension of the thread especially at the place where the twist actually is being inserted into the thread, it is possible to twist with the maximum desirable tension on every thread being twisted and to keep this tension approximately constant throughout the course of the twisting operation on every bobbin or unit of the device. In this way yarns or threads of uniform characteristics, such as their creping properties, compactness, etc. are formed. In the finished fabric formed from such yarn, therefore, the result is a more uniform hand, a more even crepe and also freedom from warp and weft bars.

In processes wherein a high degree of twist is inserted in yarns or threads it is often desirable

to treat the yarn with various reagents during the twisting operation to obtain such results as the setting of the twist, the softening of the yarn, sizing to maintain the threads in a desired condition, to tint and lubricate, etc. Therefore, a device upon which the processes of this invention may be carried out must be such that the yarn being twisted passes through a given course for at least a part of the time in which the twist is being inserted. By employing the device forming a part of this invention, the tension on the yarn is automatically regulated. However, such regulation is acquired without a change in course of the yarn over a period in which, if desired, a treatment may be applied thereto. The result of using this apparatus, therefore, is to obtain a uniform and maximum desirable tension on the yarn which results in a uniform twist between various bobbins of the same device and also between various points on the same thread, yet such apparatus does not preclude the passage of the yarn through a stationary treating device in which the yarns must travel in a constant path.

By employing this invention the highest possible twisting efficiency of a given machine may be had owing to the fact that, while the tension of the yarn can be maintained uniformly high, extremes of tension likely to break the yarn are not present. For instance, with the use of ordinary flyers, it is possible to increase the average tension to a point desired by using a heavier flyer but this is limited by the fact that it is possible to over-step the mark and obtain a low twisting efficiency because of the breaking down of ends of yarn under the influence of the extremely high tensions occurring as the twisting bobbins run empty. By employing my invention, however, this cause of the breaking of yarns or filaments is removed.

In accordance with my invention I apply twist to yarn by an upward twisting method employing a flyer whereby a uniform tension is maintained on the yarn, which uniform tension is automatically obtained by changing the direction of the thread leaving the flyer, by changing the amount of friction occurring between the thread and the metallic bars and guides and by an adjustment of the moment of force acting upon the thread as it travels from the supply bobbin to the take-up bobbin. This changing regulation of tension, however, is effected without changing the course or direction of a segment in the path of travel of the yarn in which segment the yarn may be caused to pass through a treating device. Also, in accordance with my invention, I construct a device which comprises a counterbalanced lever arm that is adapted to move, in response to the actual tension on the yarn or thread, thereby changing the direction of travel of the yarn or thread during a part of its travel while being twisted, its length and the angle of contact with certain guide elements and the applied pull exerted by a weight on the yarn.

While this invention is applicable to the twisting of yarns of all kinds, whether made of continuous filaments or short lengths of filaments or made of natural fibres or of artificial filaments, it is particularly applicable for the twisting of yarns of fine denier and/or low tenacity made of artificial filaments particularly those of substantially continuous lengths. The artificial filaments may be formed of any organic derivative of cellulose, such as organic esters of cellulose and cellulose ethers. Examples of organic esters of cellulose are cellulose acetate, cellulose for-

mate, cellulose propionate and cellulose butyrate, while examples of cellulose ethers are methyl cellulose, ethyl cellulose and benzyl cellulose. This invention is also useful for the twisting of yarns made of reconstituted cellulose such as made by the viscose, cuprammonium or Chardonnet process. Composite yarns of various kinds, as, for example, yarns combining cellulose acetate or other synthetic yarn and natural silk or other natural fibres such as wool, cotton, etc., or yarn combining two or more synthetic fibres may be twisted by my process.

The operation of this device, both in the case of ordinary flyer twisting and super twisting for crepe yarn and whether or not the yarns are treated during the twisting operation, depends on the use and coordination of at least two principles, the first principle and perhaps the most important, being the fact that, when in ordinary flyer twisting, the vertical thread proceeding from the top of the flyer towards a stationary guide above is deflected to one side so as to make an angle with the vertical, the tension on the thread becomes proportionately reduced as the angle to the vertical increases within limits. The second principle is the fact that when the thread passes over a thread guide or any such device in such a way as to describe an angle with itself, tension is put on the thread in proportion to the acuteness of the angle formed. This change in the angle of contact with the guide members will increase the amount of contact of the thread with the guide so that the tension is increased and, conversely, tension will decrease when the angle is increased. For instance, if the thread passes over one, two or more guides the tension on the yarn can be materially altered by altering the position of the guides in relation one to another in such a way that the angle of contact and length of contact of the thread with the particular guides involved is increased or decreased. In the method and device herein described, these two principles act cooperatively in accordance with requirements in such a way that though, as twisting conditions vary, the tension normally built up may change to a very great extent yet, through the compensating effect of these two cooperating principles automatically applied, the tension is maintained approximately constant.

In the particular device herein described and forming a part of this invention, it will be noted that the two coordinating factors of direction of travel of yarn and angle and distance of contact of yarn with guide members are automatically changed in coordination with the change in position of a counter-balanced lever arm carrying adjustable counter-balanced weights, which lever regulates itself in response to the variations of tension imparted to the yarn by the action of the flyer under changing circumstances. The weights may be adjusted to give any desired degree of tension upon the yarn by moving same towards or away from the fulcrum of the lever arm. The shape of the lever arm and the position of the weights mounted thereon are preferably such that as the lever arm is rotated a variable pressure is exerted by the lever arm on the yarn. Thus, a lever action is formed which regulates the two principles stated above differentially in proportion to a moment of force which varies according to the position of the lever arm and its weights as the same is rotated about its fulcrum. Thus, the movement of the lever arm shortens or lengthens the distance between the

centers of mass of the weights and a vertical line through the fulcrum of the lever arm.

As an aid to describing this invention, the same will be described with reference to the device shown in the drawing, which device also forms a part of this invention. In the device shown on the drawing there may be provided a vertical spindle 1 adapted to be rotated in any suitable manner. Spindle 1 is adapted to support a bobbin 2 or other supply package containing the supply of yarn. A collar 3 adapted to fit over the spindle 1 and be in rotative relationship thereto may be provided for supporting the flyer 4 that may be of any suitable type, for instance, consisting of a guide eyes 5 and 6 and a balancing arm 7. The spindle may ride in suitable bearings in the main frame of the device, which main frame is not shown in detail on the drawing. While a "figure 8" flyer frame is shown on the drawing, this invention is applicable to the use of other flyers, such as the "figure 4" flyer, the two arms straight flyer, or the universal flyer.

Above each vertical spindle on the device, where a bank of spindles is used, there may be provided a roller 8, suitably covered with a friction material such as cork, felt or the like, upon which a take-up spool 9 is adapted to ride and be rotated thereby due to the friction between the surfacing material on the roller 8 and the core or the yarn wound on the core of the take-up spool 9. Also mounted on the main frame may be a reciprocating arm 10 suitably driven by a source of power coordinated with the power employed for rotating the vertical spindle. Mounted on the reciprocating bar 10, in registry with or corresponding to each spool 9, may be a guide member 11. Guide member 11 may be made of any suitable material such as metal, porcelain or composition and the same may be fastened in any suitable manner to the reciprocating arm 10. Furthermore, the guide member 11 may be of any suitable shape or construction for guiding the yarn on to the take-up spool. The speed of rotation of the take-up spool 9 and the speed of reciprocation of the arm 10 taken with reference to the rate of take-up of yarn will govern the type of package formed upon the spool or other take-up package, for instance, a cheese, cone, etc., which speed may be varied according to desire.

On the main frame there may be provided a stationary member 12 running horizontally above the vertical spindle 1. A suitable bracket member 13 may be provided above each vertical spindle 1 on the device. The bracket 13 may be held in position on a stationary member 12 by means of a lug 14 threaded to receive a nut 15, the opposite ends of said lug from the threaded end being formed in an L-shape, as is shown at 16. A suitable rod or guide bar 17 may be formed as an extension of the foot of the L-shape member 16. The rod 17 may be inserted in the member 16 or be formed integral therewith. Adapted to either rotate with the guide bar 17 or rotate upon said guide bar 17, there may be provided a collar 18, which collar forms a fulcrum or pivot point of a lever arm consisting of a depending rod 19 formed with a hook 20 for engagement with the yarn and an upwardly extending arm 21 terminating also in a hook 22 for engagement with the yarn at a point above the hook 20. There may be provided, at substantially right angles to the arm 21, an auxiliary arm 23. On the arm 21 there may be provided a weight

24 adapted for adjustment lengthwise of said arm and to be held in place by a set screw 25. On the auxiliary arm 23 there may be provided a weight 26 adapted for adjustment along the length of the auxiliary arm and held in adjusted position by the set screw 27. Suitably positioned on the bracket 13 there may be provided guide bars 28 and 29. The bracket 13 is preferably shaped as shown on the drawing and has a front face 30 at substantially right angles to the main body 13 of the bracket, which front face has a cutout portion 31 adapted to allow the arm 21 to swing into a substantially vertical position without interfering with the hook member 22 thereon.

A suitable treating chamber or device 32 may be provided such that it operates on that part of the thread which follows a constant path regardless of the position of the lever arm, for instance, between the guide rods 17 and 29. For instance, a steam jacket for applying wet or dry steam to the yarn being twisted may be positioned at 32, said steam jacket having eyes through which the yarn enters the jacket and leaves the jacket on its upward travel to the take-up package or spool. In place of a steam jacket other devices may be suitably positioned at this point such as furnishing devices for furnishing lubricants, tints, sizes, etc. to the yarn, which devices may comprise a container for the treating material and a wick or roller adapted to contact with said treating material and the yarn as the yarn travels toward the take-up spool.

In operation, a supply bobbin containing yarn to be twisted, with or without the application of a treatment of steam or a coating material, is placed on the rotating spindle 1 and above it, on the spindle, is mounted the flyer 3, which flyer may be prevented from coming off the spindle by the collar or mill-nut 33. The yarn 34 is threaded through the eyes 5 and 6 of the flyer, and, as shown in Figure 2, to the left of the hook 20, to the right of the guide bar 17, to the right of the guide bar 29, to the left of the hook 22 and to the right of the guide bar 28 to the guide 11 and on to the take-up spool 9. The spindle 1 is rotated at a relatively high speed while the take-up package is rotated at a relatively slow speed, the differential between the two regulating the amount of twist inserted in the yarn.

When the supply package 2 is full as shown in solid lines on the drawing, the tension applied to the yarn by the flyer is at a minimum, at which time the weights 24 and 26 are adjusted on their respective lever arms such that the combined weights are just sufficient to maintain the lever arm substantially in the position shown in solid lines in Figure 2 of the drawing. As the supply bobbin becomes empty, the yarn tension applied by the flyer will tend to increase and the lever arm will take the position shown in dotted lines on the drawing. The tension applied to the yarn will also vary as the point at which the yarn leaves the supply package traverses the package from top to bottom and back again, increasing as the point moves toward the bottom and decreasing as it moves upwards. These variations in tension, however, will exert a corresponding variation in pull on the hook members 20 and 22. As the lever arm 21 is much greater in length than the lever arm 19, an increase in yarn tension will tend to rotate the lever arms in a clockwise direction. This clockwise

movement of the lever arms changes the position of the hook 20 on lever arm 19, causing the yarn to pass through a point spaced from a vertical line through the axis of the spindle and so to proceed from the flyer at an angle to the vertical axis of the spindle, in this way reducing the tension applied by the flyer. Also, as the lever arm is rotated in a clockwise direction, the angles described with itself by the yarn passing over the guide rods 17, 28 and 29 and the hook 22 are enlarged whereby further decrease of yarn tension tends to take place. Due to the shape of the arms of the lever containing the weight any clockwise movement of same tends to proportionately decrease the moment of force actually applied to the yarn. It will thus be seen that as the tension which is built up on the yarn 34 increase in tension will move the lever arm in a clockwise direction as viewed in Figure 2 of the drawing, and thereby reduce the applied tension on the yarn proportionately by the coordinated change in the applied pull on the yarn, the change in direction from the vertical of the yarn leaving the flyer and the changes in the angles described by the yarn upon itself in passing over the various guides. Also any reduction in the actual tension of the yarn will allow a movement of the lever in a counterclockwise direction thereby increasing the applied tension in such a manner that the actual tension on the yarn is always constant.

It is to be understood that the device shown may be considered a complete unit or a mere segment of a device. For instance, a bank containing any number of vertical spindles may be provided with a corresponding tensioning device and take-up device for each spindle, said take-up devices working from a common shaft or otherwise, the entire bank of spindles and take-up devices being operated from a single source of power. Further, devices may be formed in which there are multiple banks of spindles on one or both sides of said device as customary in twisting devices now in general use. Where a bank consisting of a multiplicity of vertical spindles is employed, the treating chamber 32 may run the entire length of the machine having guide eyes corresponding to each vertical spindle for treating the individual threads or a plurality of treating devices may be installed which are operated from the same source of power as the vertical spindles and take-up packages, such that a synchronism of moving parts may be maintained. It is to be understood also that the various parts and elements employed in forming this device may be formed of any suitable

materials adaptable for their respective purposes and may consist of metal, glass, compositions, wood, or other natural or artificial materials. It is also to be understood that variations in the shape of the lever arm and weight supporting arm or arms from that shown may be formed so long as the rotation of the yarn in the direction to decrease the applied tension on the yarn also decreases the applied moment of force exerted by the lever, and vice versa.

It is to be understood that the foregoing detailed description and drawing are given merely by way of illustration and that many variations may be made therein without departing from the spirit of my invention.

Having described my invention, what I desire to secure by Letters Patent is:

1. Apparatus for applying twist to yarn, comprising a rotating vertical spindle adapted to support a yarn supply package, a take-up package, means to rotate said package at a constant rate, a flyer adapted to assist in applying twist to the yarn, means for guiding the yarn through a constant path and means for guiding the yarn away from the axis of the flyer to relieve the tension in the yarn being wound on the take-up package.

2. Apparatus for applying twist to yarn, comprising a rotating vertical spindle adapted to support a yarn supply package, a take-up package, means to rotate said package at a constant rate, a figure 8 flyer adapted to assist in applying twist to the yarn, stationary guide bars between the take-up package and the flyer for directing the yarn through a constant path of travel, and means including a pivoted arm for guiding the yarn away from the axis of the flyer to relieve the tension in the yarn, said pivoted arm being adapted to rotate in response to the actual tension on the yarn.

3. Apparatus for applying twist to yarn, comprising a rotating vertical spindle adapted to support a yarn supply package, a take-up package, means to rotate said package at a constant rate, a figure 8 flyer adapted to assist in applying twist to the yarn, stationary guide bars between the take-up package and the flyer for directing the yarn through a constant path of travel, and means including a counterbalanced pivoted arm having yarn engaging hooks thereon for guiding the yarn relative to the axis of the flyer to relieve the tension on the yarn, said pivoted arm being adapted to rotate in response to the actual tension on the yarn.

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