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HANS-GÜNTER WILMS ETAL

3,289,957

METHOD AND APPARATUS FOR CONTROLLING A YARN-WINDING

MACHINE HAVING AN AUTOMATIC KNOTTING DEVICE

Filed June 1, 1964

2 Sheets-Sheet 1

FIG. 1a

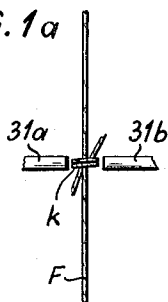


FIG. 1b

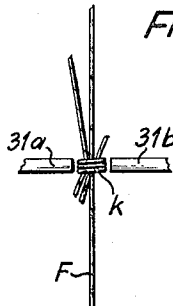


FIG. 2

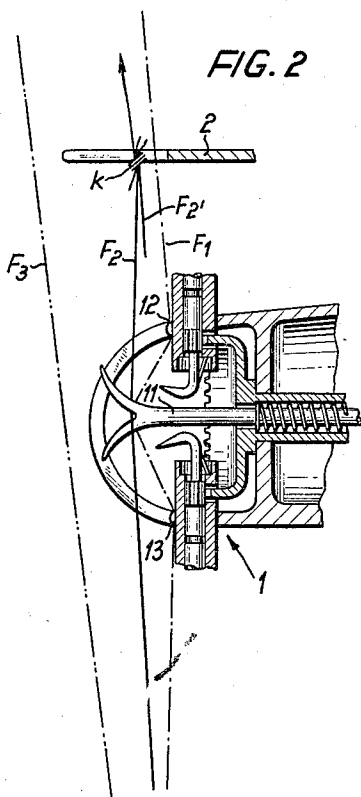
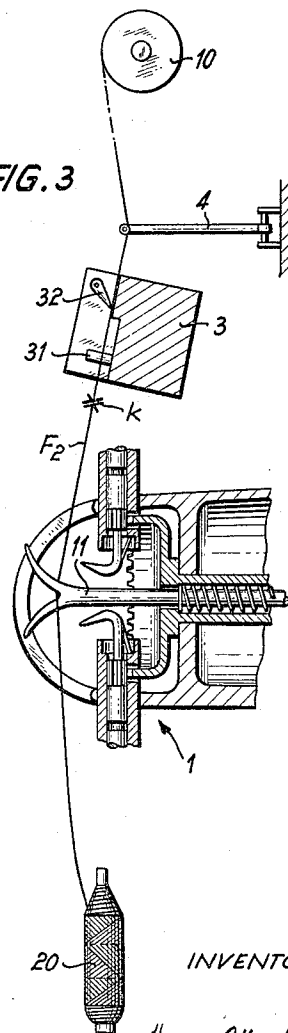


FIG. 3



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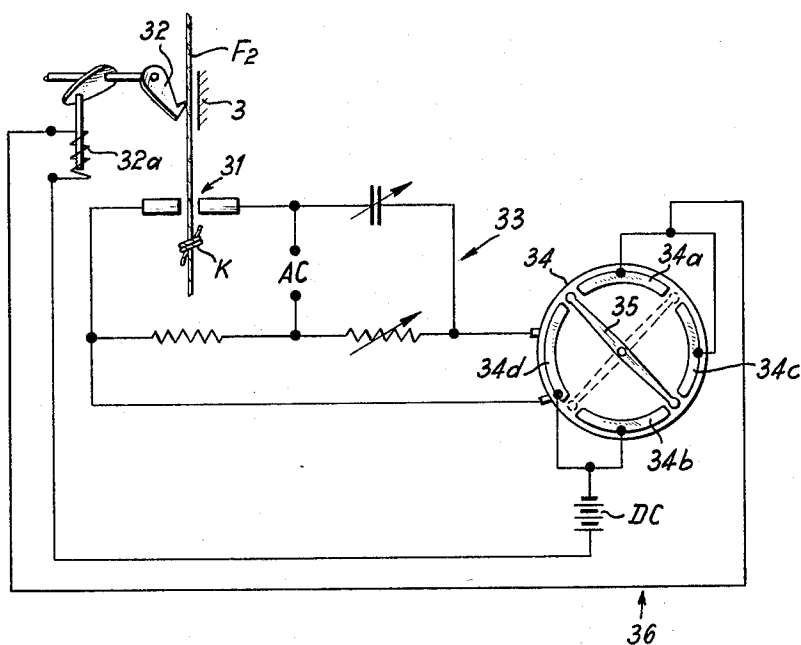
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FIG. 4



INVENTOR

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METHOD AND APPARATUS FOR CONTROLLING A YARN-WINDING MACHINE HAVING AN AUTOMATIC KNOTTING DEVICE

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Claims priority, application Germany, June 14, 1963, R 35,420

14 Claims. (Cl. 242—35.6)

Our invention relates to a method and apparatus for controlling or monitoring a yarn-winding machine of the type that has an automatic knotting device.

It is generally known that faulty knots can occur in a yarn-winding machine with an automatic knotting device due to a great variety of causes. A fault can sometimes take place, for example, by the knotting of a double yarn in which a doubled yarn length, for example in the form of a loop, instead of a single yarn length is inserted in the knotting device from one or both sides thereof. In order to eliminate such failures or faults for the most part, it has been disclosed in a copending application whereof one of us is a co-inventor, namely application Serial No. 307,077, filed September 6, 1963, now Patent No. 3,220,758, to provide the knotting device with a control mechanism which determines the number of yarn ends that are inserted in the knottor.

Another cause of failure of the knotting operation is that the knots may not be pulled together sufficiently firmly. It is, of course, known that in the formation of a so-called fisherman's knot, two individual knots are first formed and are subsequently drawn together. If these individual knots are not drawn together perfectly to form a common knot, a gap occurs between both individual knots subsequently causing the knots to loosen. It is, furthermore, known that when forming other types of knots, as for example a weaver's knot, it is possible that the knot may not be sufficiently tightened. This can also cause the knot to loosen thereafter. In order to eliminate these disadvantages, a device has also been provided which tests the completed knots for durability, for example by subjecting them to an increased tension.

It is evident that for the great variety of possible knotting failures or faults that can occur, a correspondingly great number of inspection methods and devices have been developed which entail a rather great expenditure.

It is accordingly an object of our invention to avoid the disadvantages of known devices and also to improve the method and apparatus for controlling and monitoring the knotting operation so that the expense thereof can be reduced.

To this end and in accordance with our invention we provide a method and apparatus for controlling or monitoring a yarn-winding machine having an automatic knotting device by means of which the dimensions of the completed knot are measured and when the measured dimensions deviate from a desired standard value, the faulty yarn connection or tie is severed and discarded.

Contrary to the methods and apparatuses known to date wherein the conditions that can produce a knot and that do in fact produce a knot are inspected or controlled, in accordance with our invention, the completed knot is monitored to determine if its dimensions correspond to a predetermined standard value, since a proper knot can be realized only in such case. If the knot should vary in dimension from the standard value, then no proper knot could possibly have been realized but rather a faulty knot must have been formed for example as a double yarn knot or a tie in which the knot is not tightened with sufficient firmness. In all the cases in which the dimen-

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sions of the completed knot deviate from that of a standard value, the faulty yarn tie is severed so that a new knotting attempt can be carried out culminating eventually in most cases in a proper knotting operation.

The tightness or the diameter as well as the volume of the knot, for example, can be used as the dimension of the completed knot that is to be measured. An especially certain method is provided when the textile mass of the knot is measured.

For carrying out the method of our invention, a yarn winding machine can be employed in which a measuring device for determining the dimension of a knot can be provided at the knotting device or in the path of the yarn as it passes through the winding machine behind the knotting device, and which is operatively connected with a yarn severing device.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention has been illustrated and described as a method and apparatus for controlling a yarn-winding machine having an automatic knotting device, it is nevertheless not intended to be limited to the details shown since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of the equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description when read in connection with the accompanying drawings, in which:

FIG. 1a shows a conventionally formed knot and FIG. 1b shows a so-called double yarn knot or faulty knot.

FIG. 2 is a cross-sectional view of a knottor head diagrammatically illustrating the position of the yarn at three different moments.

FIG. 3 shows the knottor head of FIG. 2 with a device for capacitively determining the textile mass of the knot in accordance with our invention; and

FIG. 4 is a circuit diagram and associated elements for operating the device shown in FIG. 3.

Referring now to the drawings and initially to FIG. 1a, there is shown a knotted yarn in which a conventional knot has been formed. In FIG. 1b there is shown a knot, however, which during knotting has formed a double yarn. It is obvious that the size of the knot in FIG. 1b is considerably larger than the conventional knot of FIG. 1a. The knot with the double yarn differs not only in thickness or diameter but also in volume and in the textile mass as compared to the conventional knot shown in FIG. 1a.

The knottor head of a knotting device 1 such as disclosed in U.S. Patents Nos. 2,981,559 and 3,110,511 and described in the aforementioned application Serial No. 307,077, is shown in FIG. 2, as well as the location of the yarn at three different moments F_1 , F_2 , F_3 . At the moment when the yarn is located at F_1 , the knot has just been tied and has been tightened by the tensioning member 11 of the knottor 1. The upper and lower yarn ends, as seen in FIG. 2, are gripped at the locations 12 and 13 in yarn clamps which are of the general type disclosed in the aforementioned U.S. Patents Nos. 2,981,559 and 3,110,511 and in application Serial No. 306,265 to Albert Pesch, filed September 3, 1963, now Patent No. 3,188,125. The dot and dash line F_3 shows the final location of the yarn after the winding station of the yarn winding machine of the type, for example, shown and described in the aforementioned application Serial No. 306,265 has been operating for a period of time and the yarn is stressed along its entire length. The intermediate position at the moment F_2 shows the location of the yarn directly after the winding station has

been started up and the yarn has been freed by the clamping means 12, 13. As shown in the embodiment of FIG. 2, the knot K has been drawn out of the knotter head of the knotting device 1 and has reached a mechanical yarn cleaner 2 of conventional construction located between the knotting device and a take-up spool (not shown). The cleaner 2 is provided with a slot that has been adjusted to a width through which a conventional knot can readily pass. When a knot has been formed with a double yarn however, as is indicated by the yarn F_2' , the diameter of the knot is so large that the knot cannot pass through the slot of the mechanical yarn cleaner. The yarn can, therefore, not be wound or drawn any further and consequently breaks.

The employment of a photoelectric device for monitoring the knot has an advantage over the aforedescribed mechanical yarn cleaning device and also of known electro-mechanical types of yarn cleaners, in that the thickness of the knot can be inspected in a comparatively simple manner and, furthermore, in addition to determining if the knot is too thick, such as for example when a double yarn knot has been formed, it can also determine when the knot is too thin due to being improperly tied. There is difficulty, however, in inspecting the knot with a photoelectric device because for example, the diameter of a double yarn knot is only about 1.3 times that of a normal knot, i.e., the increase in thickness over that of a normal knot is relatively small. Nevertheless, in many cases such optical measurement of the yarn is completely sufficient and has an important advantage in that it is of a relatively simple construction as against the considerably more complex construction of the hereinafter described device.

An absolutely certain method of testing the knot in accordance with a further aspect of our invention is by measuring the textile mass or material of the knot. Although the diameter of a double yarn knot may be only about one third larger than that of a normal knot, the amount of textile material contained in a double yarn knot is substantially twice as large as that in a normal knot. Furthermore, the mass of textile material contained in the knot is nearly independent of the tension of the yarn by means of which the knotting operation is carried out. The determination of the textile mass of the knot thus provides a considerably greater capability of distinguishing between ordinarily tied knots and faulty knots as compared with the determination of the knot thickness.

In accordance with a further aspect of our invention, we provide an electronic yarn cleaner for ascertaining the textile mass of the knot. This electronic yarn cleaner consists of a capacitive measurement bridge, whose measuring capacitors are as long as the knot in the axial direction of the yarn. With this measurement device, the dielectric constant of the air between the electrodes of the capacitor is replaced by that of the textile mass. Thus it is advantageous for the measurement capacitor in the yarn path direction to be approximately as long as the knot so as not also to include in the measurement the projecting yarn ends of the knot. The relative size of the electrodes 31a, 31b of the measuring capacitor 31 as compared to the knot itself can be seen in FIGS. 1a and 1b. If such a device is driven with the usual measuring frequency of from 10 to about 50 mHz. (megacycles), the capacitive reactance becomes very great for such a small measuring capacitor so that the device is relatively sensitive to stray fields. It is, therefore, advisable in such a case to employ a higher measuring frequency, for example 500 mHz., so that the capacitive reactance of the measuring capacitor is closer to one tenth that of the device that is driven with the usual measuring frequency. A high measuring frequency of this type, furthermore, has the advantage of permitting accurate measurement of even small changes in capacitance. The measuring frequency proper can be produced

relatively simply with transistors by conventional circuitry. Such a measurement frequency generator can be located directly near the sensing means or capacitor electrodes because of its small measurements so that troublesome high frequency cable leads are unnecessary. The measuring device proper is represented in this application for example by a conventional capacitance measuring bridge. It is, however, also possible to detune a tuned resonance circuit by the textile mass and to employ the changed frequency or the changed resonance frequency as a measuring signal.

A device for capacitively determining the textile mass of the knot is shown schematically in FIG. 3. A yarn F_2 is shown in FIG. 3 as having just been released from the clamps 12, 13 of the knotter head 1 so that the knot has moved upwardly, as shown in FIG. 3, in the direction toward a take-up spool 10 of the winding station. The capacitance measuring device 3 is located above the knotter head 1, and includes a measuring capacitor 31 and carries a severing device 32 controlled in a suitable manner by the measurement. When the textile mass of the knot passing the capacitor 31 deviates from a predetermined standard value adjusted in the capacitance measuring device 3, the difference in capacitance of capacitor 31 with respect to the standard value can actuate the severing device 32 to sever the yarn as described hereinafter with respect to FIG. 4. It is immaterial whether the knot has a mass that is greater than or less than the predetermined value. Whereas only too thick i.e. double knots, are able to be eliminated by devices for the mechanical measurement of the yarn such as is shown in FIG. 2 and described in the foregoing, and also by devices which electro-mechanically measure the yarn, with electronic measurement of the yarn as well as with the described photoelectric measurement of the knot, on the other hand, a knot that is too thin can also be eliminated.

FIG. 4 schematically shows the capacitance measuring bridge 33 which is of conventional construction, energized by an A.C. source and connected to an indicator device 34 of the galvanometer type having an electrically conducting centrally pivoted arm 35. When the yarn length F_2 of normal thickness passes between the electrodes of the capacitor 31 of the bridge 33, the arm 35 assumes the position illustrated in FIG. 4. When a thin tie is made in the yarn and passes between the electrodes of the capacitor 31 the change in dielectric constant between the electrodes increases the capacitance, and the arm 35 is pivoted clockwise so that the contact ends thereof engage the fixed contacts 34a, 34b to complete the circuit 36 and energize the relay 32a which actuates the severing device 32 to sever the faultily tied yarn F_2 .

When the knot K conforms in textile mass with a predetermined standard value, the arm 35 is pivoted to the dotted line position shown in FIG. 4 in which the secondary circuit 36 is broken and the severing device 32 is inoperative.

When the knot passing through the capacitor 31 is a faulty double knot or greater than the desired textile mass, the arm 35 is pivoted still further clockwise so that it engages the fixed contacts 34c and 34d to complete the secondary circuit 36 to actuate the severing device and cut the yarn F_2 .

It is of course understood that the device 34 can for example be replaced by a parallel system of relays which are energizable at different voltages to actuate the severing device 32. Thus circuit 36 would be energized only at a range of voltages between the voltages across the bridge 33 when the yarn F_2 of standard thickness and the knot K of standard textile mass pass through the capacitor 31, and at a voltage in excess of that for a standard knot K.

As can be visualized from FIG. 2, the knotting device 1 is located in the winding machine in such a way that the yarn runs relatively rapidly out of reach of the knotting device after the knot is tied and the winding station has been started up, and assumes the position F_3 . For a

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mechanical yarn cleaner as shown in FIG. 2, this appearance can be accepted as reasonable since the knot reaches the cleaner 2 faster than the yarn reaches the position F_3 . For the electronic measurement of the knot shown in FIG. 3 and also for many other measuring means, for example particularly a photoelectric sensing device, however, the yarn must pass through the measuring apparatus at a quite specific location since otherwise false measurements could take place. In order to insure the desired path location of the yarn, in the embodiment of FIG. 3 there is located in the yarn path behind the measuring device, a guide member 4 which guides the yarn through the measuring device shortly after the knot has been formed. As soon as the knot has passed through the measuring device 3 or has passed the guide member 4, the latter is removed so that the yarn can assume the desired position F_3 of FIG. 2. The removal of the guide member 4 can take place for example in a well known manner by pivotally mounting the guide member 4 and controlling the movement of the guide member 4 with means known in the art, for example by providing suitable linkages for actuating the guide member from the control cams of the winding machine or from the control cams of the knotting device or from the measuring impulse of the measuring device 3 or from an adjustable time period or also by the knot K engaging the guide member 4 along its entire length.

We claim:

1. Method of monitoring a knot formed by tying a pair of yarn lengths together with a knotting device of an automatic winding machine which comprises momentarily subjecting the tied yarn to a dimension-measuring device for measuring a dimension of the knot, and severing the tied yarn lengths when the measured dimension deviates from a predetermined value.

2. Method of monitoring a knot formed by tying a pair of yarn lengths together with a knotting device of an automatic winding machine which comprises momentarily subjecting the tied yarn to a thickness-measuring device for measuring the thickness of the knot, and severing the tied yarn lengths when the measured thickness of the knot deviates from a predetermined standard thickness.

3. Method of monitoring a knot formed by tying a pair of textile yarn lengths together with a knotting device of an automatic yarn winding machine which comprises momentarily subjecting the tied yarn to a mass-measuring device for measuring the textile mass of the knot and separating the tied yarn lengths when the measured textile mass of the knot deviates from a predetermined standard value.

4. In a yarn winding machine having a knotting device for tying a knot with a pair of yarn ends, means for measuring a dimension of a knot tied by the knotting device, means for momentarily placing the tied textile yarn in a position in which it is subjected to said measuring means, and means actuated by said measuring means for separating the yarn ends when the measured dimension deviates from a predetermined value.

5. In a yarn winding machine having a knotting device for tying a knot with a pair of yarn ends, means for measuring a dimension of a knot tied by the knotting device and comparing it to a predetermined value, means for momentarily placing the tied textile yarn in a position in which it is subjected to said measuring means, and severing means responsive to said measuring means for severing the tied yarn ends when the measured dimension of the knot deviates from said predetermined value.

6. In an automatic yarn winding machine including a knotting device for tying together a yarn end from a supply coil with a yarn end from a take-up spool, the knotting device being located intermediate the take-up spool and the supply coil and adjacent a path of the tied yarn extending between the supply coil and the take-up spool, a measurement device located between the knotting device and the take-up spool across the path of the tied yarn for

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measuring at a measuring location thereof a dimension of a knot tying the yarn ends together, means for momentarily placing the tied yarn in a position in which it is subjected to said measurement device, and a severing device operatively connected with said measurement device and located adjacent the yarn path between the measuring location of said measurement device and the take-up spool, said measurement device being responsive to deviation of the measured dimension of the knot from a predetermined standard value for actuating said severing device to sever the tied yarn ends.

7. In an automatic yarn winding machine including a knotting device for tying together a yarn end from a supply coil with a yarn end from a take-up spool to form a continuous yarn length movable in a path from the supply coil to the take-up spool, the knotting device being located adjacent the yarn path and intermediate the take-up spool and the supply coil, means located adjacent the yarn path and knotting device and the take-up spool for determining a dimension of the knot tied by the knotting device and for severing said yarn length when the determined dimension deviates from standard value, and means for momentarily placing the tied yarn in a position in which it is subjected to said last-mentioned means.

8. Yarn winding machine according to claim 7 wherein said means comprises a yarn cleaner having a slot of predetermined width located transversely to the yarn path and the yarn length is guidingly movable through said slot along the yarn path, the knot tied in said yarn length, when of a thickness smaller than the width of said slot, being passable through said cleaner whereby the yarn length is continuously wound on the take-up spool, and when of a thickness greater than the width of said slot, being obstructed by said yarn cleaner whereby the yarn length is prevented from being wound on said take-up spool and is broken.

9. In an automatic yarn winding machine including a knotting device for tying together a yarn end from a supply coil with a yarn end from a take-up spool to form a continuous yarn length movable in a path from the supply coil to the take-up spool, the knotting device being located adjacent the yarn path and intermediate the take-up spool and the supply coil, electronic measuring means located adjacent the yarn path and between the knotting device and the take-up spool for determining at a measuring location the textile mass of the knot tied by the knotting device, means for momentarily placing the tied yarn in a position in which it is subjected to said measuring means, and severing means operatively connected with said measuring means and located adjacent the yarn path between said measuring location and the take-up spool, said measuring means being responsive to deviation of the determined textile mass of the knot from a standard value for actuating said severing means to sever the yarn length.

10. Yarn winding machine according to claim 9 wherein said electronic measuring means comprises a capacitance measuring bridge including a capacitor having spaced electrodes, the yarn path extending between said electrodes.

11. Yarn winding machine according to claim 10, said capacitor having a pair of electrodes with spaced opposing faces, the yarn length being movable along the yarn path between said electrode faces, the length of said faces in the direction of the yarn path being substantially equal to the length of a knot taken in the axial direction of the yarn length.

12. Yarn winding machine according to claim 10 including movable contact means movable in response to change of capacitance of said capacitor for energizing a severing device actuating circuit whenever the textile mass of the knot deviates from the standard value, whereby the yarn length is severed.

13. In an automatic yarn winding machine including a knotting device for tying together a yarn end from a supply coil with a yarn end from a take-up spool to form

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a continuous yarn length movable in a path from the supply coil to the take-up spool, the knotting device being located adjacent the yarn path and intermediate the take-up spool and the supply coil, a measurement device located between the knotting device and the take-up spool adjacent the path of the yarn length for measuring at a measuring location thereof a dimension of a knot tying the yarn ends together, means for momentarily placing the tied yarn in a position in which it is subjected to said measurement device, a severing device operable by said measurement device and located adjacent the yarn path between said measuring location and the take-up spool, said measurement device being responsive to deviation of the measured dimension of the knot from a predetermined standard value for actuating said severing device to sever the tied yarn ends, and a guide member located between said measurement device and said take-up spool for guiding the yarn length in the yarn path past said measurement device.

14. Yarn winding machine according to claim 12 wherein said guide member is pivotable out of guiding engage-

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ment with the yarn length when the measured dimension of the knot corresponds to the standard value.

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