Dec. 27, 1966 H. RAASCH 3,294,326
DEVICE FOR CHECKING THE OCCURRENCE OF FAULTY KNOTS
IN YARN-WINDING MACHINES
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FIG. 1

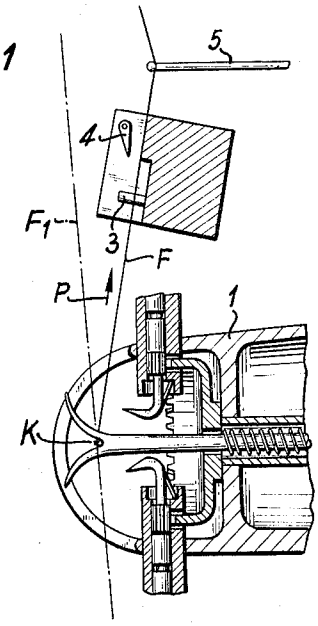
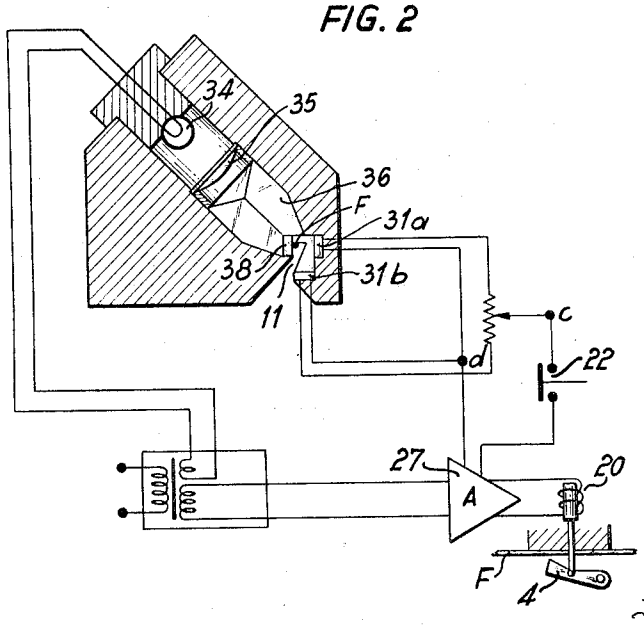


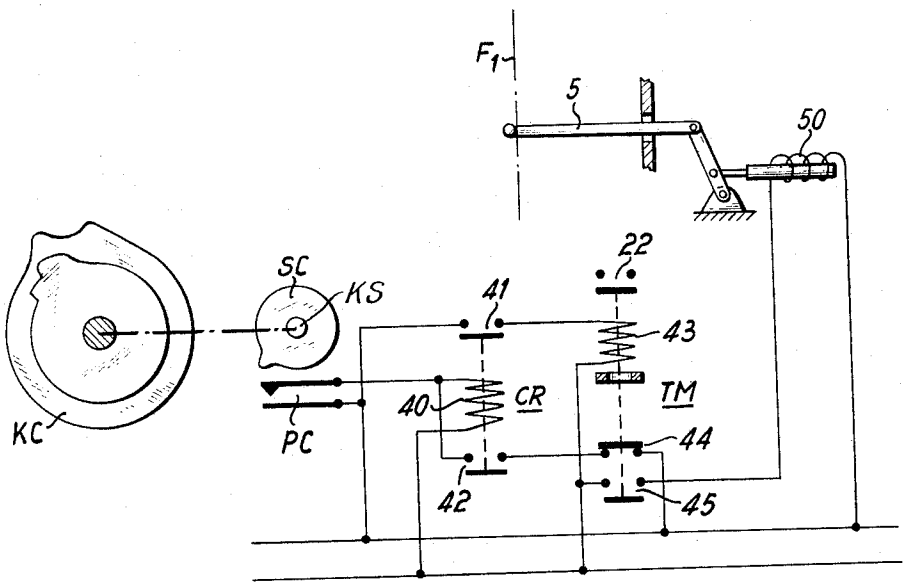

FIG. 2




INVENTOR
Hans Raasch

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FIG. 3




INVENTOR
Hans Raasch

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3,294,326

# DEVICE FOR CHECKING THE OCCURRENCE OF FAULTY KNOTS IN YARN-WINDING MACHINES

Hans Raasch, Rheydt, Germany, assignor to Walter Reiners, Monchen-Gladbach, Germany

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My invention relates to a device in yarn-winding machines for detecting the occurrence of faulty knots and preventing them from being passed onto the yarn package being wound.

In automatic yarn-package winding machines equipped with an automatic knotting device, the occurrence of faulty knots may come about by the fact that a double thread or loop rather than a single thread, is placed into the knotter from one or both sides thereof, such knots and the yarn in their vicinity being too thick because of the doubling of the yarn ends.

A proposal has been made to prevent such faults by providing the automatic knotter with a checking device which determines the number of yarn ends placed into the knotter. It has been found, however, that it is not always feasible to mount one or two such checking devices on the knotter. Another proposal for preventing double threads in knots, therefore, is based upon measuring the dimensions of the completed knot. When the knot exceeds a predetermined size, a cutter is to be actuated for severing the knotted yarn. In practice, difficulties have been encountered due to the fact that the difference between a knot of two single threads and a knot formed of a single and a double thread is sometimes smaller than a difference that may simply result from variation in the yarn thickness. For example, it is possible that with yarns of non-uniform thickness, a knot tied from a double thread may be thinner than the average single-thread knot. It is therefore necessary that the measuring or sensing member in the device be given an extremely fine adjustment notwithstanding that even under most favorable conditions an appreciable percentage of incorrect sensing and unnecessary severing of the yarn must be contended with. In addition, the knot ends may affect the performance because there is no assurance that the knot ends of different knots are always the same.

It is an object of my invention greatly to minimize or obviate the above-mentioned deficiencies and to provide a device for checking the occurrence of faulty knots which reliably responds only to doubling of yarn ends and affords a much higher precision and a much lower percentage of malfunctions or unnecessary severing operations than heretofore encountered.

Another object of my invention is to provide a knot-checking device of the type mentioned which is particularly well suited for use with yarns of greatly irregular thickness.

Still another object of my invention is to provide a knot-checking device generally of the type described above which becomes active and enters into sensing relation to the yarn only when a checking activity, immediately following a knotting operation, is needed, but is normally completely disengaged from the yarn so as not to impede or otherwise interfere with the yarn travel.

To achieve these objects, and in accordance with a feature of my invention, the device for checking the occurrence of faulty knots in a winding machine is provided with a sensing member mounted near the yarn travel path at a location behind the knotter of the winding machine relative to the direction of the yarn travelling to the winding location, the sensing member being



responsive to a given limit dimension, such as the thickness or volume of the yarn, to emit a signal when this limit dimension is exceeded. I further provide yarn-severing means operatively connected to the sensing member to be controlled by the just-mentioned signal for the purpose of severing the knotted yarn when the sensing member responds to the occurrence of the limit dimension due to doubling of knotted yarn ends.

When the critical dimension to which the sensing member is to respond consists of the volume, the sensing member may essentially constitute an electrical capacitor and respond capacitively to changes in yarn volume at the sensing location. In cases where the critical dimension of the yarn consists of its diameter, a sensing member is preferably photoelectric.

Since the knot itself, as a rule, is considerably thicker than a single length of yarn or even a doubled yarn end, I further provide means, according to another feature of my invention, which eliminate any effect of the knot upon the sensing member. One way of doing this, for example, is by interposing a time delay member in the connection between the sensing or measuring member and the yarn-severing device, thus delaying the response of the yarn-severing device a given interval of time. If under these conditions the measuring distance, i.e. the distance between the knotter and the sensing member, is kept sufficiently short, the time required for the knot to travel from the knotter through the measuring distance amounts to but a few milliseconds even for a slow starting speed. Consequently, by connecting a time delay member into the control circuit of the severing means, the severing means, such as a cutter, can be made to operate only after the measuring or sensing signal has exceeded a given critical value for a given length of time. Alternatively, the cutter itself can be constructed as a time delaying device, for example by providing it with electromagnetic actuating means having a relatively high inductance. It is particularly advantageous to have the delay period adjustable in order to adapt the performance of the device to different speeds respectively of the winder spindle and hence to respectively different yarn travel speeds.

According to still another feature of my invention, the sensing member responsive to the yarn dimension is mounted outside of the normal yarn path along which the yarn travels when it is being wound upon the package being formed.

For this purpose, a yarn-guiding member is preferably mounted at a location behind the sensing member relative to the yarn travel direction, and is movable for temporarily shifting the yarn path away from its normal run and through the sensing location of the sensing member. This also results in greatly simplifying the proper adjustment and control of the sensing device. For example, the signal value measured by the sensing member, such as an electric output voltage, may be indicated by a measuring instrument while the yarn, after knotting, is being passed through the sensing location a given length of time by operation of the yarn-guiding member. The measuring instrument then permits reading the value of the signal, and the threshold for the response of the yarn-severing device can then be so adjusted that it will be above the ascertained measuring value for a properly tied knot.

For processing non-uniform or irregular yarns, it is in some cases particularly advantageous to employ a photoelectric measuring method such as described for example in the copending application Serial No. 307,077, filed September 6, 1963, now Patent No. 3,220,758, of which I am coinventor. According to this method, the yarn is illuminated by two intersecting beams of light, and the shadow of the yarn is thrown onto two photocells mount-

ed at right angles to each other. By suitably forming the yarn-guiding contours along the measuring distance, the two threads, in the event of a doubled yarn end, are located at such a position along the measuring distance that the shadow of one thread appears on one photocell while the shadows of both threads appear on the other photocell. The resulting voltage or current difference between the two cells, when exceeding a given threshold value, is accordingly applied for controlling the operation of the above-mentioned yarn-severing means. Since this method operates independently of the yarn thickness, it would, in theory, be applicable also for yarns having different dernier values without requiring any adjustment. Practical use, however, has shown that the threads are not always of such uniform roundness that when a single thread is placed along the measuring distance no difference at all is discernible between the effects upon the two photocells. It is, therefore, advisable slightly to calibrate the threshold value or the amplification depending upon the thickness of the particular yarn being processed, although this calibration need not be particularly precise.

The invention may further by applied by performing a sensing or measuring operation in short time intervals as the yarn passes through the sensing location and in such a manner that an equal number of measuring values respectively preceding and following the travelling knot is added and stored. The two stored sum totals are then compared with each other. If the two totals are equal, it is then concluded that the yarn ends on both sides of the knot were equal. If the two total values differ from each other, then it is an indication that an appreciably thicker yarn or a yarn of double thickness or so-called double yarn must have been located either in front of or at the rear of the knot. The difference thus resulting from the comparison can, therefore, be applied for controlling the above-mentioned cutter or other severing means.

The above-mentioned and more specific objects, advantages and features of my invention, the features being set forth with particularity in the claims annexed hereto, will be apparent from, and will be mentioned in, the following with reference to embodiments of devices according to the invention, illustrated by way of example in the accompanying drawings, in which:

FIG. 1 shows schematically a first embodiment of the checking device according to my invention in conjunction with the knotter of a yarn-package winding machine.

FIG. 2 shows schematically a photoelectric sensing member and a yarn cutter electrically controlled by the sensing member.

FIG. 3 is a schematic circuit diagram applicable in conjunction with a device as shown in FIGS. 1 or 2.

Referring to FIG. 1, there is shown the head portion of a knotting device **1** and the yarn F represented by a full line in a position of its path obtaining shortly after the knotter, mounted near a first position of the yarn path, has completed the formation of a knot K and hence after the yarn has just been released by the grippers of the knotter. Normally, however, the yarn passes from a supply coil (not shown) upwardly along the path shown by a dot-and-dash line $F_1$ toward the take-up spool (not shown) on which a package is being wound. The knotter **1** is of a known design as fully described and illustrated for example in U.S. Patent No. 2,981,559 of Stefan Fürst, and also described in the aforementioned copending application Serial No. 307,077, filed September 6, 1963. At the instant represented in FIG. 1, the knot K is not as yet ejected from the knotter. At the next instant, however, the knot K will be released and will then travel in the direction of the arrow P upwardly toward the yarn package. Mounted above the knotter and consequently behind the knotter relative to the yarn travel direction, is a sensing device equipped with a measuring or sensing member **3** which is responsive to a dimension of the yarn F, such as its diameter. The sensing member **3** is in controlling connection with a normally inactive cutter **4**. When the sensor **3** responds to the yarn dimension exceeding a given datum value, the cutter **4** is actuated and the yarn is severed.

The illustrated checking device is further equipped with a yarn-guiding member **5**, located at a second position of the yarn path, which, upon completion of the knot, moves to the right and thereby entrains the yarn from its normal path $F_1$ to the full-line path F for a short interval of time, thus passing the yarn temporarily through the sensing location of the sensor **3**. The moment the yarn-guiding member **5** has returned to the left position, the yarn again travels on its normal path $F_1$. It will be recognized from FIG. 1 that before the knot K enters into the measuring distance along which the sensor **3** is effective, a specific length of yarn ahead of the knot is subjected to the sensing operation. The length of the yarn end behind the knot K, which the sensor **3** subsequently checks, depends upon the moment when the yarn is released by the yarn-guiding member **5** to return to its normal path $F_1$.

FIG. 2 shows as an example a sensing device in which two beams of light are thrown crosswise upon the travelling yarn in accordance with the device more fully described in the above-mentioned copending application Serial No. 307,077. The yarn F is guided by suitable gripper or holding members, such as the yarn-guiding member **5** shown in FIG. 1 as well as in the hereinafter described FIG. 3 so as to pass into a slot **11** in which it glides along a wear-resistant glass prism **38**. The rays of light issuing from a lamp **34** are rendered parallel by a selector lens **35**, and the beam is then split in prisms **36** so that two component beams issue vertically and horizontally from these prisms. The respective vertical and horizontal beams of light throw a shadow which is normally of the same width as the yarn upon respective photoelectric cells **31***a* and **31***b*.

However, if two lengths of yarn enter into the measuring slot **11**, then these two threads are located beside each other on the glass prism **38** and two shadows, one for each thread, are thrown onto the photocell **31***a*, whereas only one shadow appears on the cell **31***b*.

The two photoelectric cells are connected in respectively different legs of a bridge network having two other legs formed by respective portions of a resistor R which has a tap point *c*. Point *c* constitutes a diagonal point of the bridge and furnishes relative to the other diagonal point *d* an output voltage which is balanced by proper adjustment of the tap *c* to the zero value when only one yarn shadow appears on each of the two photocells. However, when one cell exhibits two shadows and the other only one shadow, the bridge is unbalanced, and the resulting finite output voltage between diagonal points *c* and *d* is amplified in an amplifier **27** and controls an electromagnet **20** which actuates the above-mentioned cutter **4** of the yarn-severing device, the cutter being normally biased, for example by a spring (not illustrated) to inactive position.

When the yarn is being shifted into the measuring distance location within the slot **11**, it is possible that at first only one shadow may be thrown upon only one of the photocells which would have the result of releasing a cutter-operating signal pulse. For that reason, a switch **22** is interposed between the diagonal point *c* and the amplifier **27** and is coupled with the switch or control devices of the winding machine, for example with the control devices of the knotter, in such a manner that the switch **22** interrupts the input circuit of the amplifier **27** whenever the yarn is being inserted into the measuring gap or is being removed therefrom. In other words, the operation of the switch **22** causes the amplifier **27** to be controllable by the output voltage of the measuring bridge only during those intervals of time in which a measuring or sensing operation is effected, for example when, after tying of a knot, the winding machine begins to run up to the instant at

which the yarn-guiding member 5 permits the yarn to return to its normal position as denoted by $F_1$ in FIG. 1.

The circuit diagram illustrated in FIG. 3 exemplifies one of various ways of securing the above-described sequential control performance. In FIG. 3, the set of control cams for operating the knotter 1 of FIG. 1 is denoted by KC, these control cams and their operation being in accordance with the corresponding components in the knotter illustrated and described in the above-mentioned copending application Serial No. 307,077. It will be understood that the control cams KC and the appertaining cam shaft KS constitute a connection with the control devices of the winding machine since the knotter operates automatically in dependence upon occurrence of yarn breakage or yarn depletion in the winding machine. A switch control cam SC is mounted on the cam shaft KS and actuates a pulse contact PC in proper time relation to the operation of the knotter. When contact PC closes, it energizes the coil 40 of a control relay CR. The relay picks up and thereafter holds itself energized through a self-holding contact 42. The main contact 41 of control relay CR now energizes a timer TM, here simply shown as a relay which has a delayed pick-up and a likewise delayed drop-out operation. After a given timing interval, the timer TM energizes the coil 50 which actuates the yarn guide member 5 in the above-described manner, thus moving the yarn from position $F_1$ to position F according to FIG. 1. The yarn is now located in the measuring gap 11 of the photoelectric sensing device according to FIG. 2. The switch 22, shown in FIG. 3 to be directly connected with timer TM although it may also form part of a separate delayed pick-up relay, simultaneously closes the input circuit of the amplifier 27 (FIG. 2) so that the above-described sensing operation can take place. After a given further interval of time, the timer TM drops out and opens the contacts 22 and 45 thus deenergizing the coil 50 so that the yarn guide member 5 permits the yarn to return to the original path $F_1$ while the input circuit of the amplifier 27 is opened by switch 22.

To those skilled in the art, it will be obvious upon a study of this disclosure, that my invention permits of various modifications and may be given embodiments other than illustrated and described herein, without departing from the essential features of the invention and within the scope of the claims annexed hereto.

I claim:

1. A device in winding machines for checking the occurrence of faulty knots due to doubling of yarn ends, comprising means defining a first travel path from a first to a second position for yarn to be wound, a knotter for knotting a pair of yarn ends mounted near said path intermediate said first and second positions, a sensing member mounted near but spaced from said first path between said knotter and said second position and responsive to a given limit dimension of the knotted yarn, travelling from said first to said second position, means for momentarily diverting the yarn from said first travel path between said first and second positions to a second travel path located between said positions and extending through the operating zone of said sensing member when a knotting operation is performed, and yarn severing means connected with said sensing member and controlled thereby to sever the yarn when said member responds to said limit dimension due to doubling of knotted yarn ends.

2. A device in winding machines for checking the occurrence of faulty knots due to doubling of yarn ends, comprising means defining a first travel path from a first to a second position for yarn to be wound, a knotter for knotting a pair of yarn ends mounted near said path intermediate said first and second positions, an electric sensing member having an output voltage responsive to a given limit dimension of the yarn, said sensing member being mounted near but spaced from said first path between said knotter and said second position, means for momentarily diverting the yarn from said first travel path between said first and second positions to a second travel path located between said positions and extending through the operating zone of said sensing member when a knotting operation is performed, and yarn severing means mounted between said sensing member and said second position and electrically connected therewith so as to be controlled by said voltage to sever the knotted yarn travelling from said first to said second position when said member responds to said limit dimension due to doubling of knotted yarn ends.

3. A device in winding machines for checking the occurrence of faulty knots due to doubling of yarn ends, comprising means defining a first travel path from a first to a second position for yarn to be wound, a knotter for knotting a pair of yarn ends mounted near said path intermediate said first and second positions, a photoelectric sensing member having an output voltage responsive to a given limit dimension of the yarn, said sensing member being mounted near but spaced from said first path between said knotter and said second position, means for momentarily diverting the yarn from said first travel path between said first and second positions to a second travel path located between said positions and extending through the operating zone of said sensing member when a knotting operation is performed, and yarn cutter means electrically connected with said sensing member so as to be controlled by said voltage to sever the knotted yarn travelling from said first to said second position when said member responds to said limit dimension due to doubling of knotted yarn ends.

4. A device in winding machines for checking the occurrence of faulty knots due to doubling of yarn ends, comprising means defining a travel path from a first to a second position for yarn to be wound, a knotter for knotting a pair of yarn ends mounted near said first position of said path, a sensing member mounted in spaced relation to said path at a place between said knotter and said second position, said sensing member, when engaged by the knotted yarn, being responsive to a given limit dimension of the yarn, a yarn guide member engageable with the knotted yarn at said second position on said path and movable for temporarily shifting the yarn into engaging relation with said sensing member, control means connected to said knotter and said guide member for controlling said guide member to operate in a given time relation to the completion of a knotting operation, and yarn severing means connected with said sensing member and controlled thereby to sever the knotted yarn travelling from said first to said second position when said member responds to said limit dimension due to doubling of knotted yarn ends.

5. A checking device according to claim 4, comprising time delay means interposed between said sensing member and said severing means for causing the severing operation to occur in a given time relation to the sensing operation.

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STANLEY N. GILREATH, *Primary Examiner.*

MERVIN STEIN, *Examiner.*