CONTROL DEVICE FOR A WINDING MACHINE

Rudolf Jenny, Thawil, Switzerland, assignor to Maschinenfabrik Schweiter AG, Horgen, Switzerland

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The present invention relates to an improved control mechanism for controlling the bobbin locations or winding units of an automatic winding machine.

In prior known automatic winding machines there is provided for the drive of the individual winding bobbins a motor-driven shaft which is common to all bobbin locations or winding units, and to which shaft each of the winding bobbins is operatively connected in a manner permitting for uncoupling or disengagement. If the thread is not present at a bobbin location or winding unit, for example in consequence of yarn or thread breakage, this condition is determined by a suitable sensing member, for example a feeder which cooperates with the thread, and thereafter the relevant drive spindle for the winding unit is disengaged and braked.

Then a mechanism which advantageously automatically remedies the thread breakage occurs in the ends of the threads to be knotted together and knots them. Additionally, means are provided through the intermediary of which the drive spindle has imparted thereto a reverse movement necessary for the suction operation which is at a reduced rotational speed with respect to the normal or operating rotational speed. Upon completion of the knotting operation the spindle of the winding bobbin is again coupled or engaged, so that it is caused to rotate with the desired rotational speed in the forward direction.

However, a disadvantage of such known type of winding machines is that, the winding bobbin upon completion of the knotting operation is immediately again brought up to its full rotational speed without first determining the renewed presence of the thread or yarn. As it has been discovered in practical operation, the knotting operation can prove unsuccessful, or the thread can possess imperfections in the region directly adjacent the knotting location which can then cause a renewed yarn or thread breakage. Due to the relatively large lapse of time from the moment of switching to the full rotational speed and up to the time of determination of thread breakage and again rendering the relevant winding unit stationary, owing to the inertia of the mechanical uncoupling means and the large moving masses which are to be braked, the high peripheral speed of the winding bobbin is maintained for such a long period of time that the thread end can easily become caught or imbedded into the windings of the yarn package previously formed on said winding bobbin. This can result in the condition that the suction force of the thread suction device is then no longer sufficient to remove the thread from the winding bobbin.

Accordingly, the present invention has as one of its prime objects to provide an improved control device which effectively overcomes the disadvantages of the prior known devices.

The present invention is generally characterized by the fact that means are provided for achieving a forward running of each winding bobbin upon completion of the knotting operation at a reduced rotational speed with respect to the normal rotational speed, and further that control means are provided which upon determination of the renewed presence of the thread or yarn permit of a switching of the relevant winding unit from its forward running at the aforesaid reduced rotational speed to the normal forward running speed. By virtue of such a construction of the control device it is now possible to considerably reduce the danger of the thread or yarn end from becoming imbedded or pressed into the yarn package on the winding bobbin as aforesaid, since the winding bobbin upon completion of the knotting operation initially rotates at a reduced rotational speed; and indeed for such length of time until the yarn feeder has determined the renewed presence of the yarn, whereupon the winding unit is re-engaged and thereby again brought up to its normal rotational speed.

Another important object of the present invention is to provide an improved control device for the winding units of a winding machine permitting of effective braking of the relevant winding unit when the thread is no longer being wound onto the winding bobbin thereof, then suitably reverses rotation of the winding bobbin in a manner enabling execution of a thread locating and knotting operation, and upon completion of the aforesaid knotting operation rotates the winding bobbin at a reduced forward running speed with respect to the normal forward running speed until it has been determined that the thread has again been knotted and is present for renewed winding, whereupon the winding bobbin is then brought from the reduced running speed up to said normal running speed.

A further object of the present invention is to provide an improved control mechanism for winding machines and the like which substantially prevents or minimizes the danger that a broken thread or yarn end will become imbedded in the yarn package of the winding bobbin.

Yet another important object of the present invention is the provision of an improved control mechanism for winding machines and the like permitting braking of the winding unit directly at the winding bobbin when thread breakage or exhaustion occurs, to thereby prevent or considerably minimize the danger that a broken thread or yarn end will become imbedded in the yarn package of the winding bobbin of said winding unit.

Still further objects and the entire scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description and specific examples, while indicating a preferred embodiment of the invention, are given by way of illustration only since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

In the single figure there is schematically illustrated a circuit diagram of the inventive control mechanism arranged at a bobbin location or winding unit of a cross-winder.

Referring now to the drawing where only enough of the winding machine has been illustrated to enable one skilled in the art to fully understand the underlying principles of the invention, it will be appreciated that there is schematically illustrated an embodiment of a control mechanism designed according to the invention, wherein a bobbin location or winding unit, generally represented by reference numeral 71, of a cross-winder exhibiting a number of such winding units, as for example illustrated and described in the commonly assigned United States
3 Patent 3,062,462, invented by Walter Schweiter, granted November 6, 1962, for "Device for Driving Winding Bobbins in Automatic Cross-Winders," has provided there- with a drive motor 72. This drive motor 72 drives via a belt drive 73 a winding bobbin 74 provided with a grooved drum 74a, as is known to the art. A thread or yarn supplied to the winding bobbin 74 is thus capable of being wound upon such winding bobbin 74 to form a yarn package. Along the path of travel of the yarn 75, between a supply spool or cop 76 and the winding bobbin 74, there is arranged an electronic yarn feeder or sensing unit 77 which checks for the presence of the thread or yarn 75. Yarn sensing means suitable for this purpose are well known to the art, so that a further description thereof is not believed to be necessary. A suitable electronic motor regulating device 78 is electrically coupled with the drive motor 72 by means of which this motor may be adjusted in a stepless or continuous manner to a predetermined normal or operating rotational speed and in a predetermined rotational sense, for example, in accommodation of the different yarn qualities or properties being processed by the cross-winder. The regulating device 78 is thus constructed in such a manner as to adjust the drive motor 72 in response to appropriate externally delivered signals for forward travel of the winding bobbin 74 at the desired normal rotational speed, for return or reverse movement or forward movement, at a smaller rotational speed than the normal forward rotational speed. This regulating device 78 comprises a controllable rectifier circuit wherein the controllable elements are, for example, silicon-controlled rectifiers. Regulating devices for motors employing silicon-controlled rectifiers suitable for the purposes of the present invention are described in the pamphlet entitled "Power Seminar Papers," of Texas Instruments Incorpor- ated. Furthermore, a regulating device of the type suit- able for use in the present invention can be obtained from the company Transistor AG. of Zurich, Switzerland. The electric signals for actuating or switching the motor regulating device 78 are transmitted from switch members associated with a control unit or device 79 provided for correcting yarn breaks, whereby one switch member 80 is provided for the normal forward movement, a switch member 81 for the forward movement at reduced rotational speed, and a switch member 82 for the reverse movement of the drive motor 72. The switch members 80, 81 and 82 are actuated by means of a contact 83 driven by a motor 83. The control- 85 shaft 85 is provided with mechanical, movable elements 84 provided for carrying out the knitting operation. In the rest condition of the control unit 79 the switch member 80 for the normal forward running of the drive motor 72 is closed and transmits a continuous signal to the regulating device 78, by means of which said regulating device maintains the drive motor 72 at its proper normal forward running speed. Now, if, the electronic yarn feeder 77 during operation of the winding machine determines the absence of the yarn 75, in consequence of yarn breakage for example, then such yarn feeder 77 transmits a suitable signal to an electronic switch 86 which couples-in an electromag- neatic relay 87. This relay 87, in turn, interrupts the signal for influencing normal forward running of the drive motor 72 and the winding bobbin 74 transmitted via relay contact 87a, by opening such contact, whereby the drive motor 72 is stopped via the regulating device 78. In order to achieve an immediate arresting of the winding bobbin 74 after having stopped the drive motor 72, the spindle of such winding bobbin 74 is advan- tageously provided with an electromagnetic brake 88 which during the normal winding operation is connected in parallel with the drive motor 72, and which then becomes operative when there is present an interruption of the voltage for shutting-off the drive motor 72. The release or switching-off of the electromagnetic brake 88 occurs parallel with the switching-off of the drive motor 72 by means of the contact 87c of the relay 87. A relay contact 87b is simultaneously closed when the relay contacts 87a and 87c are opened, whereby the control motor 83 is switched-in and the control shaft 85 is brought into rotational movement. During the ther- eupon initiated knotting operation, the switch member 82 is then initially actuated by the relay 87c, which then delivers a suitable signal to the motor regulating device 78 which influences a reverse movement of the bobbin drive motor 72, necessary for the knotting opera- tion. In order to free the bobbin brake 88 to carry out this reverse movement, the latter is switched-in dur- ing the predetermined timeprovided for such reverse movement via a switch member 89 likewise actuated by the control shaft 85. Upon expiration of the time pro- vided for the reverse movement, the signal influencing such reverse movement as well as the signal for the brake 88 is again interrupted, whereby the winding unit is again brought into its rest condition. If the sub- sequent mechanical knotting operation is completed the switch member 81 actuated by the control shaft 85 transmits an appropriate signal to the regulating device 78, by means of which such regulating device 78 switches the drive motor 72 into the normal forward rotational speed, again at the same time the brake 88 has applied thereeto a voltage via the switch member 89 and, thus, releases the winding bobbin 74. Now, if the yarn feeder 77 detects the renewed presence 80 of the yarn 75, then it again transmits a signal to the electronic switching switch 86 wherein upon said electronic switch back the relay 87. Consequently, the relay switch or contact 87c is closed, as shown, and transmits to the electronic regulating device 78 the signal for the normal forward running of the drive motor 72 delivered from the switch 80 actuated by the control shaft 85, the latter of which in the meantime has returned into its starting position and, thereby, by opening of the switch member 81 arrests the slower forward movement. As a result, the winding bobbin 74 winds the yarn with a normal forward rotational speed. Simultaneously with the closing of the contact 87c the contact 87a is closed and thereby the brake 88 is released and the control shaft 85, whereby the control motor 83 is shut-off. On the other hand, if the knotting of the two yarn or thread ends has not been successful, then the signal delivered by the yarn feeder 77 and indicating non- presence of the yarn is maintained, whereupon, in view of the relay contact 87b remaining open, the control motor 83 continues to rotate and the knotting operation is again repeated in the aforementioned manner. In order to be able to limit the number of repetitions of the knotting operation, there is electrically coupled with the control motor 83 of the control unit or mechanism 79 a time relay 90 which, after the elapse of a predeter- mined period of time corresponding to a number of repeated knotting operations, switches-off the control motor 83 and switches-in an optical signal 91, or an acoustical signal or otherwise in order to indicate in an appropriate manner the rest condition of the winding unit 71. In order to stop the control shaft 85 with the movable elements 84 e.g. cams exactly in the starting position, that is, in order to cut-out the time relay 90 the latter is bridged by a switch 90a actuated by the control shaft 85 via the cam 85a and rod 85b. This switch 90a, when the time relay 90 is switched-out allows the motor 83 to rotate further until the starting position of the control shaft 85 is again reached. It is to be noted and appreciated that the illustrated devices permit a braking of the grooved drum and eventu- 95 ally the winding bobbin not only in the presence of yarn breakage, but, rather also in the case of the reverse rotational movement. In this manner it is possible to prevent the danger of winding onto the grooved drum the yarn unwound from the winding bobbin.
The aforedescribed electronic operating control device has the advantage in comparison with a mechanical operating variant, that it works practically without inertia. As a result, the relatively long cut-off time from the moment of yarn rupture up to arresting of the winding unit—owing to the inertia of the mechanical starting means and the larger moved masses to be braked, as for example that of the grooved drum and the drive means—can be considerably shortened, whereby the danger of pressing-on or imbedding the yarn end in the yarn windings on the winding bobbin can be still further minimized.

While there is shown and described a present preferred embodiment of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practised within the scope of the following claims.

Having thus described the present invention, what is desired to be secured by United States Letters Patent is:

1. In a winding machine having a plurality of winding units onto each of which a respective yarn is wound in a package, and if breakage of the yarn during winding onto its winding unit occurs the broken yarn ends undergo a knotting operation, each winding unit including a winding bobbin adapted to be rotatably driven to wind a yarn package thereon, a supply cop for each winding unit for delivering yarn to its associated winding unit to be wound thereon in a package, a control mechanism for each winding unit comprising drive means for driving the winding bobbin of an associated winding unit at a predetermined normal speed in a first direction of rotation for normally winding yarn into a package, at a speed slower than said predetermined normal speed also in said first direction of rotation for winding yarn into a package upon said winding bobbin to take up the slack in the yarn between its supply cop and said winding unit produced by a knotting operation, and at a speed slower than said predetermined normal speed in a second direction of rotation for unwinding a portion of yarn from the package upon said winding unit upon breakage of the yarn during winding onto the winding unit, means for controlling operation of said drive means to enable the latter to drive the associated winding unit at said slower speed in said second direction of rotation upon determination of renewed presence of the yarn for further winding by said associated winding unit, and feeder means operatively connected with said controlling means responsive to the presence of yarn to operate said controlling means for changing the speed of said drive means.

2. In a winding machine as defined in claim 1; wherein said drive means comprises a separate drive motor for each winding bobbin of each winding unit, said controlling means comprising electronic motor regulating means electrically coupled with each drive motor for regulating the speed and direction of rotation of said drive motor, a control motor regulating means in circuit with said motor regulating means.

3. In a winding machine as defined in claim 2; said control unit including switch members, said controlling means further including electric yarn sensing means for controlling operation of said control unit.

4. In a winding machine as defined in claim 3; wherein said electronic motor regulating means is provided with means for the stepless regulation of the normal speed of the drive motor, means for regulating the drive motor for running at said predetermined normal speed in said first direction, means for regulating the drive motor for running at the slower speed in the second direction, said aforementioned means of the electronic motor regulating means each being operably connected with a separate switch member of said control unit.

5. In a winding machine as defined in claim 2; wherein each winding bobbin is provided with a spindle, an electromagnetic brake for each spindle operable upon the associated winding bobbin responsive to operation of the drive motor for such winding bobbin.

6. Control device for the winding units of a winding machine of the type wherein a yarn is delivered from a supply cop and wound in a yarn package onto an associated winding unit, and if breakage of the yarn during winding onto the winding unit occurs the broken yarn ends are subjected to a knotting operation, comprising, in combination: at least one winding unit, a supply cop for delivering yarn to said winding unit to be wound thereon in a package, drive means for driving said winding unit at a predetermined normal speed in a first direction of rotation for normally winding yarn into a package, at a speed slower than said predetermined normal speed also in said first direction of rotation for winding yarn into a package upon said winding unit to take up the slack in the yarn between the supply cop and said winding unit produced by a knotting operation, and at a speed slower than said predetermined normal speed in a second direction of rotation opposite said first direction for unwinding a portion of yarn from the package upon said winding unit upon breakage of the yarn during winding onto the winding unit, means for controlling operation of said drive means to enable the latter to drive said winding unit at any of the aforementioned speeds and direction of rotation in a predetermined sequence, and feeder means operatively connected with said controlling means responsive to the presence of yarn to operate said controlling means for changing the speed of said drive means.

7. Control device for the winding units of a winding machine of the type wherein a yarn is delivered from a supply cop and wound in a yarn package onto an associated winding unit, and if breakage of the yarn during winding onto the winding unit occurs the broken yarn ends are subjected to a knotting operation, comprising, in combination: at least one winding unit, a supply cop for delivering yarn to said winding unit to be wound thereon in a package, drive means for driving said winding unit a predetermined normal speed in a first direction of rotation for normally winding yarn into a package, at a speed slower than said predetermined normal speed also in said first direction of rotation for winding yarn into a package upon said winding unit to take up the slack in the yarn between the supply cop and said winding unit produced by a knotting operation, and at a given speed in a second direction of rotation opposite said first direction for unwinding a portion of yarn from the package upon said winding unit upon breakage of the yarn during winding onto the winding unit, means for controlling operation of said drive means to enable the latter to drive said winding unit at said given speed in said second direction upon yarn breakage, then to drive said winding unit in said first direction of rotation at said speed slower than said predetermined normal speed upon completion of a knotting operation of the yarn being wound onto said associated winding unit, and then to drive said associated winding unit at said predetermined normal speed in said first direction of rotation upon determination of renewed presence of the yarn for further winding by said associated winding unit, and feeder means operatively connected with said controlling means responsive to the presence of yarn to operate said controlling means for changing the speed of said drive means.

8. Control device for the winding units of a winding machine of the type wherein a yarn is delivered from a supply cop and wound in a yarn package onto an associated winding unit, and if breakage of the yarn during winding onto the winding unit occurs the broken yarn ends are subjected to a knotting operation, comprising, in combination: at least one winding unit, a supply cop for delivering yarn to said winding unit to be wound thereon
in a package, drive means for driving said winding unit at a predetermined normal speed in a first direction of rotation for normally winding yarn into a package, at a speed slower than said predetermined normal speed also in said first direction of rotation for winding yarn into a package upon said winding unit to take up the slack in the yarn between the supply cop and said winding unit produced by a knotting operation, and at a speed slower than said predetermined normal speed in a second direction of rotation opposite said first direction for unwinding a portion of yarn from the package upon said winding unit upon breakage of the yarn during winding onto the winding unit; means for controlling operation of said drive means to enable the latter to drive said winding unit at said slower speed in said second direction upon yarn breakage, then to drive said winding unit in said first direction of rotation at said speed slower than said predetermined normal speed upon completion of a knotting operation of the yarn being wound onto said winding unit, and then to drive said winding unit at said predetermined normal speed in said first direction of rotation upon determination of renewed presence of the yarn for further winding by said winding unit, and means responsive to the presence of yarn to operate said controlling means for changing the speed of said drive means.

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MERVIN STEIN, Primary Examiner.