

[54] **APPARATUS FOR MONITORING YARN AT WINDERS**

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[56]

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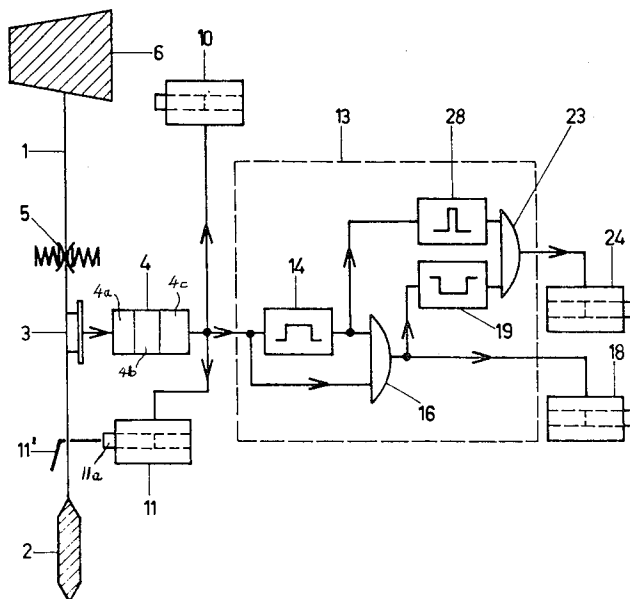
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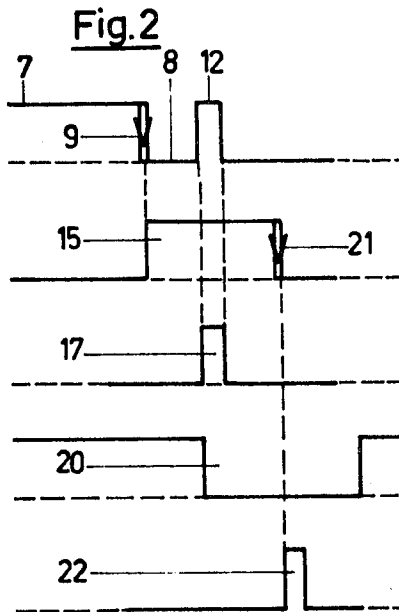
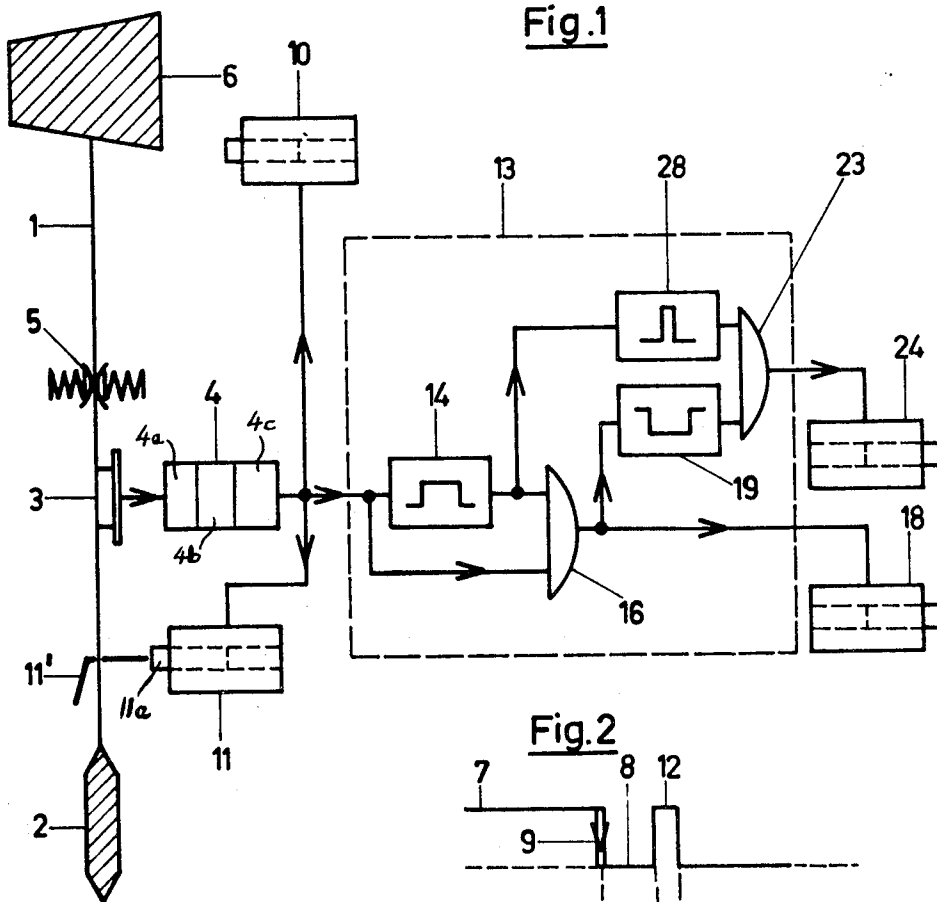
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ABSTRACT

An apparatus for monitoring a yarn at a winder which comprises a tribo electrical transducer for determining the presence of a stationary yarn, an interrogation mechanism operably associated with the yarn, and means for actuating the interrogation mechanism when the speed of travel of the yarn has fallen below a predetermined boundary value so that the interrogation mechanism can generate a relative movement between the transducer and the yarn which is sufficient to produce a response signal by the transducer.

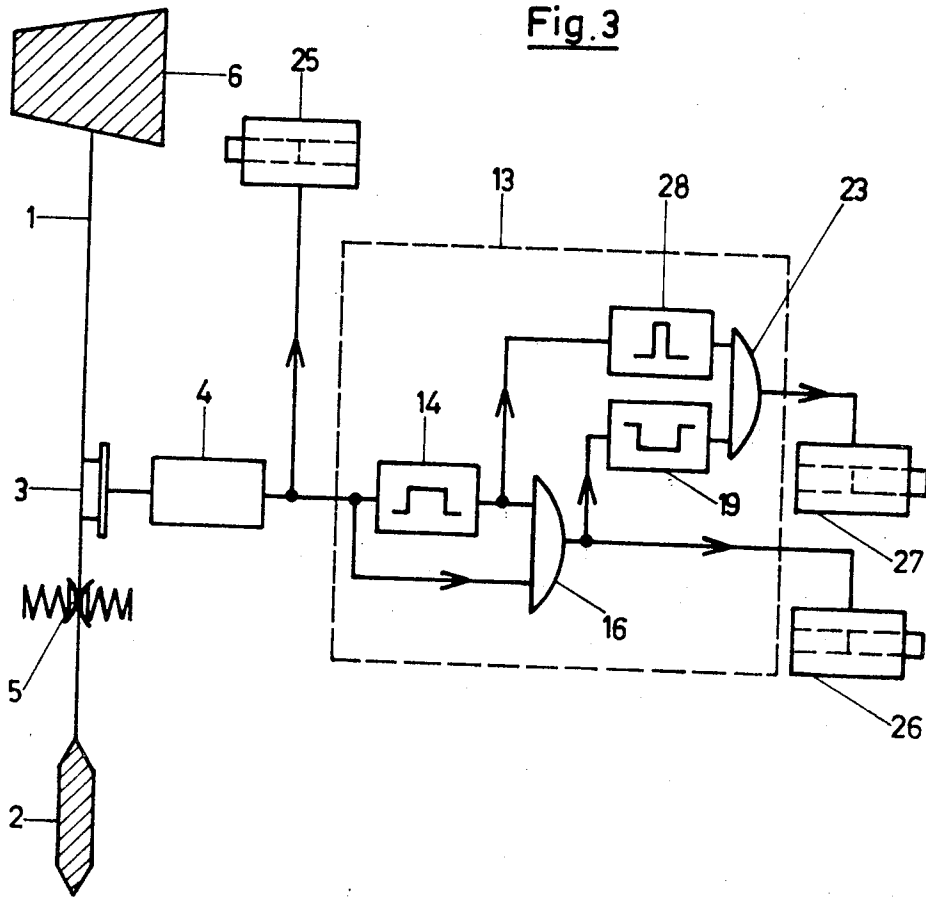
11 Claims, 3 Drawing Figures





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Fig. 3



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APPARATUS FOR MONITORING YARN AT WINDERS

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved apparatus for monitoring a yarn at a winder, especially an automatic cross-winder machine.

Those familiar with cross-winders are well acquainted with the fact that the so-called automatic servicing or tending mechanism is supposed to rectify all interruptions which might occur during the continuous winding operation. These interruptions, for instance, may be characterized, among others, by all types of rupture of the yarn caused by weak locations at the yarn, excessive yarn tension owing to loops or thicker yarn sections or locations and so forth. Rupture of the yarn can occur at any random location of the free running yarn extending between the supply or delivery cop and the wind-up bobbin, typically referred to as the cross-wound bobbin. Activation of the yarn cleaner likewise normally brings about cutting of the traveling yarn. Further interruptions of the continuous winding operation occur during such time as the delivery cop becomes depleted and upon reaching the completely wound package or filled condition of the wind-up bobbin.

Following such interruption it is necessary in order to restore the continuous winding operation, depending upon the nature of the interruption, to carry out automatic knotting of the yarn ends, and an exchange of the delivery cop or the wind-up bobbin. Each of these three automatically carried out restoration operations is limited to a given yarn condition. If a different condition prevails then the restoration work must be performed by means of a different automatic tending or servicing mechanism. For instance, most of the automatic knotting devices are not capable of seeking and retrieving the yarn at or in the neighborhood of the delivery cop so that when yarn rupture occurs in the neighborhood of the delivery cop an automatic knotting operation cannot be undertaken, rather it is necessary to exchange the delivery cop, even if such still is not yet completely empty. In a quite similar manner the automatic exchange mechanism for the cross-wound bobbin can generally only then apply a new sleeve and again start-up the winding unit if the yarn connected with the removed fully wound package or bobbin is still intact.

In automatic cross-winders it is a function of the control mechanisms to initiate the correct restoration work as a function of the momentarily existing condition of the yarn at the period of time that an interruption in the winding process occurs. To develop this concept further it must be understood that the expression "condition of the yarn" first of all is intended to denote the presence or absence of the stationary yarn within a given spatial area, and secondly, additionally denotes the movement or standstill of a yarn in the direction of the lengthwise axis of the yarn.

The heretofore known control mechanisms generally use different devices for checking the presence-non-presence of the stationary yarn (so-called "yarn presence monitors") and for monitoring lengthwise movement-standstill of the yarn (so-called "yarn travel monitors"). Certain of the state-of-the-art yarn travel monitors incorporate pivotable mechanical brackets which are retained in a given position by the traveling yarn

owing to its rigidity and tension, the brackets being held, as explained above, by the yarn in such predetermined position against the action of a restoring force of a spring. Should the yarn rupture then the bracket will be pivoted by the action of the spring. The need to perform delicate adjustments, the presence of frequent binding and other defects have resulted in the manufacture of improved yarn travel monitors which usually are electronic in nature. These electronic yarn travel monitors either employ a yarn travel signal which is generated as a function of the roughness and irregularity of the yarn surface during yarn travel, or else, for instance, a yarn travel signal which is generated by virtue of the traversing motion occurring during the winding operation.

Suitable as yarn presence monitors are mechanical feelers in the form of bifurcated or forked members, rakes, needles and the like which are blocked in movement by a stationary yarn which is present. However, these type monitors likewise are subject to the disadvantages of requiring critical adjustments, frequent binding and unreliable operation when working with thin yarns.

SUMMARY OF THE INVENTION

Therefore, it will be understood from what has been discussed above that a real need still exists in the art for improved apparatus for monitoring the yarn of a winding machine which is not associated with the aforementioned drawbacks of the prior art constructions. Hence, a primary object of this invention is to provide just such apparatus which effectively and reliably fulfills the existing need in the art.

Another and more specific object of the present invention relates to a new and improved construction of apparatus for monitoring the yarn of a winding machine, especially a cross-winder, which is relatively simple in construction, extremely reliable in operation, not readily subject to breakdown, and affords accurate and efficient monitoring operations.

In particular, it has been found that the drawbacks of the known mechanical feelers can be prevented when using a so-called tribo electrical or frictional electrical transducer. In accordance with a preferred embodiment of the present invention such type transducer can perform both the function of the yarn travel monitor as well as that of the yarn presence monitor at an automatic cross-winder.

Tribo electrical yarn monitors and transducers suitable for the purposes of the present invention are well known to the art, as for instance disclosed in Swiss Pat. 479,478 and in my commonly assigned, co-pending United States application, Ser. No. 833,030, filed June 13, 1969, now U.S. Pat. No. 3,676,769 and entitled "Method And Apparatus For Detecting A Relative Movement Between Two Bodies Being In Contact With Each Other," and to which reference may be readily had. Generally speaking such type transducer which can be used as a yarn feeler preferably encompasses a friction element, an electrode and a housing formed of electrically conductive material and serving as a screening element. The traveling yarn produces potential or voltage fluctuations at the friction body or element which is preferably formed, for instance, or ceramic, these potential fluctuations being delivered through the agency of the electrode to an amplifier, the output signal of which has the form of a noise voltage.

An integrator shapes such output signal into a direct-current voltage signal possessing a well defined amplitude, and a subsequently connected Schmitt-trigger ensures that the beginning as well as the end of the yarn signal is well defined. With the yarn traveling there prevails at the output of the entire arrangement the binary potential "one," i.e., the logical signal "1," and with the yarn stationary the binary potential "null," i.e., the logical signal "0."

A preferred physical manifestation of the inventive apparatus contemplates the provision of a tribo electrical transducer for determining the presence of a stationary yarn, an interrogation mechanism which is operably associated with the yarn, and means for actuating the interrogation mechanism when the speed of travel of the yarn has fallen below a predetermined boundary or threshold value, so that the interrogation mechanism produces a relative movement between the transducer and the yarn which is sufficient for generating a response signal by the transducer.

Now in accordance with an extremely preferred physical embodiment of this apparatus the tribo electrical transducer is employed as the yarn presence monitor and simultaneously, consistent with its known function, as the yarn travel monitor for controlling the winder. This is possible because surprisingly it has been found that the tribo electrical transducer also delivers a signal which can be exceptionally well evaluated even at very low yarn travel speeds beneath 10 m/min. The presence of a stationary yarn is determined in that there is generated a slight relative movement between the yarn and the friction body of the tribo electrical transducer. This can be realized, for instance, by a slight forced movement of the yarn, for instance by briefly starting-up the cross-wound bobbin or by performing a slight sudden deflection of the yarn out of its normal position. By virtue of this forced relative movement between the yarn and the friction body of the transducer the apparatus therefore, apart from being used for the function of a yarn travel monitor, additionally can assume in the most simple fashion the function of a positively functioning yarn presence monitor.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a schematic circuit diagram of a first embodiment of the invention;

FIG. 2 is a graph serving to explain the associated curve or diagram of the electrical pulses, wherein the null or zero line has been illustrated broken; and

FIG. 3 is a second embodiment of the inventive apparatus which has been modified somewhat from the embodiment of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Considering now the drawings, it is to be understood that for the purpose of simplifying the illustration only enough of the actual textile machine with which the monitoring apparatus of the invention can be successfully employed, has been shown in order to enable one versed in the art to fully understand and appreciate the underlying concepts of this invention. Turning atten-

tion now more particularly to the initial embodiment under consideration as depicted in FIG. 1, it is to be understood that the yarn 1 travels from the wind-off spool or delivery cop 2 past a tribo electrical transducer 3, when through the yarn brake 5 and finally is wound-up upon the wind-up spool 6, typically referred to in the art as the cross-wound bobbin or package. An electronic circuit 4 is coupled with the tribo electrical transducer 3, and an evaluation circuit 13 is electrically coupled in turn with this electronic circuit 4. Now as long as the yarn is intact and travels in contact with the transducer 3 as shown in FIG. 1, the latter delivers tribo electrical signal to the electronic circuit 4 which as a result delivers a continuous direct-current voltage signal characterizing a yarn travel signal 7, as best seen by referring to FIG. 2. On the other hand, if the yarn 1 should rupture for some reason then this signal disappears, a null potential 8 then appearing at the output of the electronic circuit 4. Thus the trailing edge 9 of the signal characterized yarn rupture or disappearance. The trailing edge signal actuates an electromagnet 10 by means of which the drive means (not shown) of the cross-wound package 6 is brought to standstill. The trailing edge signal 9 further actuates a different electromagnet 11 equipped with an interrogation element 11' by means of which the lower yarn portion situated at the region of the transducer 3 is somewhat deflected. To this end the interrogation element or member 11' is operatively connected with the movable armature 11a of the electromagnet 11. By means of this interrogation movement the transducer 3 in conjunction with the electronic circuit 4 can determine whether the upper yarn portion between the yarn brake 5 and the cross-wound package 6 or the lower yarn portion between the yarn brake 5 and the delivery cop is present or broken. Hence, if the yarn is ruptured at a location between the yarn brake 5 and the cross-wound bobbin 6, then, during the interrogation movement of the interrogation element 11' the electronic circuit 4 associated with the transducer 3 delivers a response pulse 12 (FIG. 2). On the other hand, if the location of the yarn rupture occurred between the yarn brake 5 and the delivery cop 2 then this response pulse is absent.

The electronic circuit 4 will be understood to contain a number of conventional electrical circuits, the details of which are not essential to the understanding of the invention since it will be apparent that suitable circuits of this nature are already well known in the art. Therefore, as schematically indicated in FIG. 1 electronic circuit 4 will be seen to embody a conventional amplifier circuit 4a, a conventional rectifier and smoothing circuit 4b, such as an integrator circuit for instance, and a conventional signal shaper circuit 4c, for instance a Schmitt-trigger.

Now the operation of the evaluation circuit 13 in the case that the yarn is broken between yarn brake 5 and bobbin 6, however, is present between cop 2 and brake 5 and contacts transducer 3 will be considered. In this case, the electronic circuit 4 produces a trailing edge signal 9 and a response pulse 12 as described above and shown in FIG. 2. The trailing edge signal 9 of the yarn travel signal 7 triggers a monostable multivibrator 14 which delivers an interrogation pulse 15. The multivibrator 14 is designed and dimensioned such that the interrogation pulse 15 encompasses in time the response pulse 12 of the electronic circuit 4, sometimes hereinafter referred to as transducer circuit 4. The pulses 12

and 15 are delivered to an AND-gate 16 which, in turn, delivers a control pulse 17 to an electromagnet 18 when, during the presence of the interrogation pulse 15 there arrives the response pulse 12, that is to say, when the lower yarn portion is intact. Electromagnet 18 then places the drive means (not shown) of an automatic knoter into operation.

The control pulse 17 further triggers the monostable multivibrator 19, at the output of which there normally exists the potential "one" so that a null pulse 20 is produced. The monostable multivibrator 19 is designed and dimensioned such that the null pulse 20 encompasses in time the descending flank 21 of the interrogation pulse 15. The interrogation pulse 15 is also delivered to a monostable multivibrator 28 which as a result delivers a second control pulse 22. The null pulse 20 and the second control pulse 22 derived from the descending flank 21 of the interrogation pulse 15 by means of a monostable multivibrator 28 are delivered to an AND-gate 23. Since now the null pulse 20 blocks AND-gate 23, the second control pulse 22 cannot pass this gate, and the electromagnet 24 is not actuated. In the case that the yarn breaks between yarn brake 5 and cop 2, or the yarn runs out when the cop is depleted, a trailing edge signal 9, an interrogation pulse 15 and a control pulse 22 are produced, however, there will be no response pulse 12, and no control pulse 17 and null pulse 20. That means that the electromagnet 18 is not actuated, however, the second control pulse 22 passes the AND-gate 23 as an indication that the lower yarn portion is not intact. The second control pulse 22 therefore actuates the electromagnet 24 to start up the drive means (not shown) of an automatic exchange mechanism serving to exchange the delivery cop.

Now with the embodiment of FIG. 3 the tribo electrical transducer 3 is arranged above the yarn brake 5 and therefore is operably associated with the upper yarn portion. A non-illustrated mechanism of any conventional construction and therefore not shown, measures continuously the degree of filling of the cross-wound bobbin or package 6. It is here to be assumed for instance that this mechanism has just sensed and indicated that the bobbin 6 has just reached a fully wound package condition and that as a result thereof the drive for such cross-wound bobbin is interrupted, for instance by raising the aforesaid cross-wound bobbin from the driving grooved drum of conventional design and therefore likewise not shown. Owing to the inertia of the fully wound package or bobbin 6 placing such into a stationary condition does not occur suddenly, so that upon reception of the command for placing such fully wound bobbin into its stationary condition there is still wound a quantity of yarn which is not inconsequential. Consequently, there further exists a condition rendering yarn rupture probable.

The decision whether a knotting operation should be performed or whether the cross-wound package or bobbin should be exchanged can be determined by the tribo electrical yarn monitor of FIG. 3 and consisting of the transducer 3 and the electronic circuit 4, in the following manner: the trailing edge signal 9 of the yarn travel signal 7 (FIG. 2) signifies either a yarn rupture or the standstill of the cross-wound bobbin with the yarn still intact. The descending trailing edge signal 9 actuates an interrogation element, here in the form of the interrogation magnet 25 which, with the arrangement according to the embodiment of FIG. 3, re-

activates the drive (interrupted as stated above) of the cross-wound bobbin 6 to be briefly driven. The construction and design of the evaluation circuit 13 of this embodiment is the same as that of the embodiment of FIG. 1, so that the same reference characters have been conveniently selected for the same or analogous components, and likewise the signal sequence is here similar to that considered with regard to FIG. 2. Now if during interrogation with the yarn intact there appears the response pulse 12, then, the AND-gate 16 delivers a control pulse 17 to the electromagnet 16 which places the automatic servicing or tending mechanism of the cross-wound bobbin into operation. On the other hand, if the yarn is ruptured and the control pulse 17 is absent, then, the AND-gate 23 delivers a control pulse 22 to the electromagnet 27 which places into operation the automatic knoter.

It should be apparent that the performance of two functions, namely that of yarn travel monitor and that of yarn presence monitor, by a single element, namely the transducer 3, provides considerable advantages in contrast to known comparable devices. Firstly, the entire described monitoring apparatus is predicated upon a non-mechanical principle so that here the yarn presence monitor is freed of the inadequacies of mechanically operating devices. Additionally, the considerable advantages of a tribo electrical transducer simultaneously come to the forefront for both functions: there is performed a faultless delivery of signals for all standard yarn materials and yarn thicknesses, and specifically even under the more difficult conditions which prevail at textile machines, namely concerning dust and mechanical vibrations.

The embodiments illustrated by way of example in FIGS. 1 and 3 can be modified, of course, in a number of different ways. Thus in the event that a mechanical yarn monitor is already provided for at the winder and of the type incorporating a yarn feeler lever, then shut-down of the wind-up bobbin or cross-wound bobbin and the actuation of an interrogation element can be brought about by the yarn feeler lever. In such case the interrogation movement can be transmitted to an interrogation element corresponding to element 11' by means of mechanical intermediate elements arranged between the yarn feeler lever and the interrogation element.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims. Accordingly, What is claimed is:

1. An apparatus for monitoring a yarn at a winder, comprising a tribo electrical transducer means for determining the presence of a stationary yarn, an interrogation mechanism operably associated with the yarn, and means for actuating the interrogation mechanism when the speed of travel of the yarn has fallen below a predetermined threshold value so that the interrogation mechanism can produce a relative movement between the transducer means and the yarn which is sufficient for generating a response signal by said transducer means.

2. The apparatus as defined in claim 1, wherein said interrogation mechanism comprises a mechanical element positively acting upon the yarn.

3. The apparatus as defined in claim 1, wherein said interrogation mechanism comprises electromagnetic means actuated by an electrical trigger signal, said electromagnetic means incorporating a movable armature capable of positively acting upon the yarn.

4. The apparatus as defined in claim 1, wherein said interrogation mechanism serves to deflect the yarn out of a given position.

5. The apparatus as defined in claim 1, wherein said winder incorporates a driven wind-up bobbin, said interrogation mechanism serves to subject the yarn to a lengthwise movement by briefly activating the driven wind-up bobbin.

6. The apparatus as defined in claim 1, wherein said winder incorporates a driven wind-up bobbin, said means serving to actuate said interrogation mechanism comprises an electronic circuit with which said transducer means cooperates, said electronic circuit delivering a continuous yarn travel signal when the yarn is moving, said yarn travel signal possessing a trailing edge when the yarn is broken or has run out serving to stop the wind-up bobbin and serving as trigger signal for the interrogation mechanism.

7. The apparatus as defined in claim 6, wherein said electronic circuit embodies an amplifier circuit followed by a rectifier circuit and a pulse shaper circuit so that there is produced a direct-current voltage signal serving as the yarn travel signal and having a well-defined trailing edge.

8. The apparatus as defined in claim 6, further including an actuation mechanism for initiating a knotting operation or bobbin change operation, an evaluation circuit operatively connected with said electronic circuit, said evaluation circuit upon the occurrence of a response signal, following a trigger signal delivered by the electronic circuit, delivers at least one control signal for actuating said actuation mechanism for the knotting operation or bobbin change operation.

9. The apparatus as defined in claim 8, wherein said evaluation circuit comprises an AND-gate having a pair of inputs, one of said inputs directly being connected with the output of said electronic circuit and the other

input being connected through the agency of a monostable multivibrator with the output of said electronic circuit.

10. The apparatus as defined in claim 8, further including a delivery cop and a winding unit where the yarn delivered from said delivery cop through a given path of travel is wound as a yarn package, a yarn brake disposed intermediate said delivery cop and said winding unit in the path of travel of the yarn between said delivery cop and said winding unit, a first actuation mechanism in circuit with said evaluation circuit for carrying out a knotting operation and a second actuation mechanism in circuit with said evaluation circuit for carrying out exchange of the delivery cop, said transducer means and said interrogation mechanism being effective at the region of the lower portion of the yarn prior to entry into said yarn brake, and upon occurrence of a response signal said first actuation mechanism for the knotting operation is triggered and upon absence of the response signal following a yarn travel-terminal signal there is actuated the second actuation mechanism for the exchange of the delivery cop.

11. The apparatus as defined in claim 8, further including a delivery cop and a winding unit, said delivery cop serving to supply yarn along a predetermined path of travel to the winding unit to wind the yarn thereat in the form of a full-wound bobbin, a yarn brake disposed intermediate said delivery cop and said winding unit at said predetermined path of travel, a first actuation mechanism for exchanging the wound bobbin, a second actuation mechanism for initiating a knotting operation, said transducer means and said interrogation mechanism being effective at the region of the upper portion of the yarn after passing said yarn brake, and upon occurrence of a response signal after stopping the full-wound bobbin said first actuation mechanism for carrying out exchange of the full wound bobbin is triggered, and upon the absence of a response signal after placing the wound bobbin into a standstill condition said second actuation mechanism is triggered for carrying out a knotting operation.

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