March 5, 1968 E. FELIX 3,371,568

METHOD AND APPARATUS FOR CHECKING KNOTS

Filed March 28, 1966 2 Sheets-Sheet 1

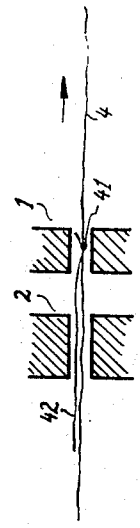

Fig. 2

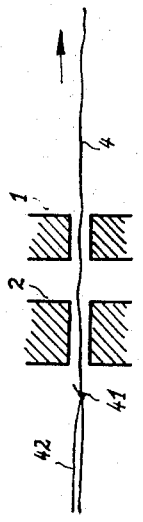

Fig. 1

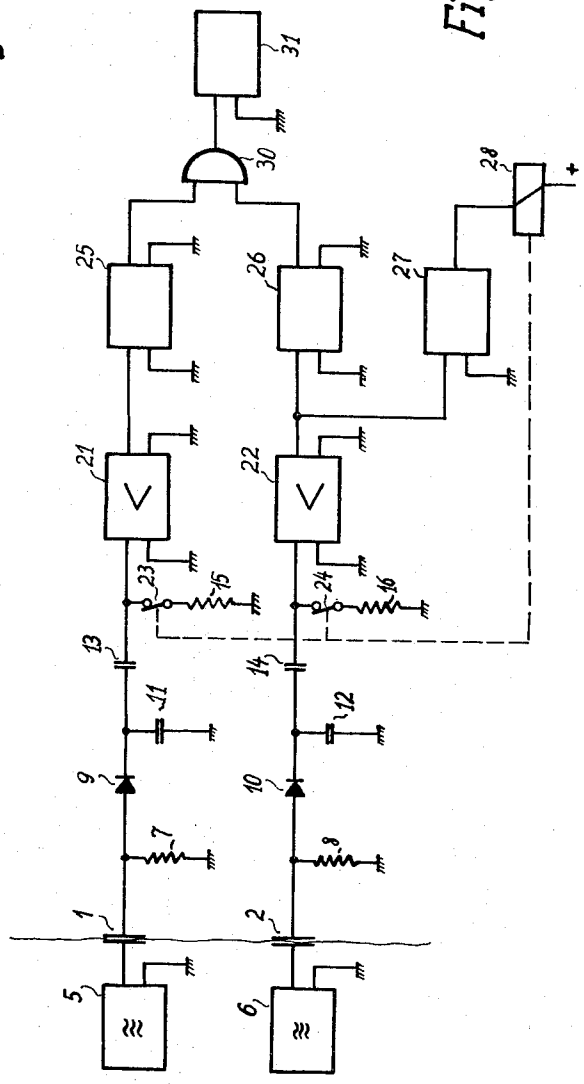

Fig. 3

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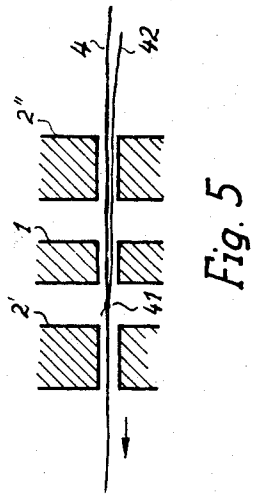

Fig. 5

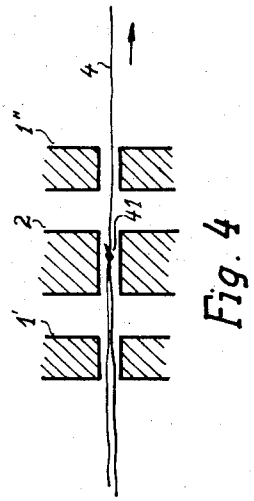

Fig. 4

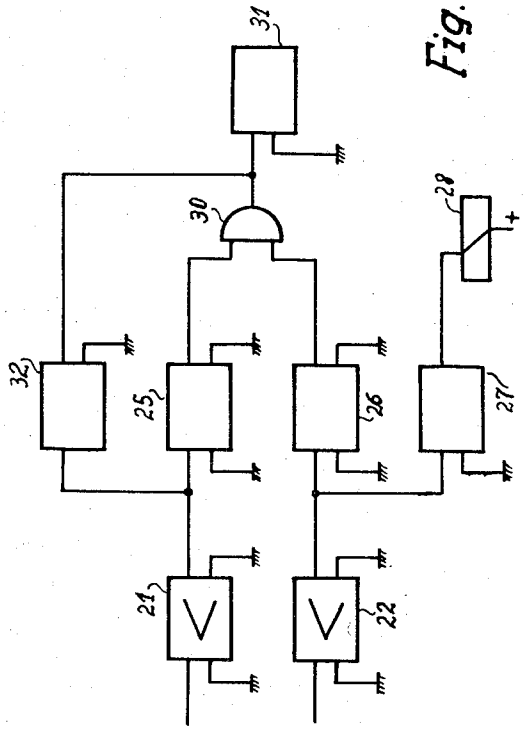

Fig. 6

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METHOD AND APPARATUS FOR CHECKING KNOTS

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10 Claims. (Cl. 83—13)

ABSTRACT OF THE DISCLOSURE

The present invention relates to methods and apparatus for checking knots in threads processed in the textile industry and for removing defective knots. In this invention a plurality of sensors are used to detect both the presence of a knot and the cross section of the thread in the vicinity of the detected knot. A thread cutter is actuated upon detection of the simultaneous presence of both a first signal indicative of the sensing of a knot and a second signal indicative of the sensing of a thread cross section in excess of a predetermined size.

In the textile industry, and particularly during the spooling process, the knotting of two threads together is a frequent operation, particularly when spooling threads. In the case of manually operated spooling machines the knotting process is done manually, whereby visual checking of the knot is possible. However, automatic spooling machines have lately appeared on the market wherein visual checking is no longer possible. Since derangements often occur during the knotting operation, it is necessary that the knots be checked. Among the chief derangements that occur are either incomplete severance or lack of severance of the so-called remnant threads at the time of knotting so that for some reason a third thread is knotted incorrectly. Efficacious checking of these knots must therefore check both the size of the knot and the immediate vicinity of the knot to detect the presence of the remnant threads.

Heretofore, mechanical knot monitors have been known which have been adjusted to a particular size of knot so that when that size is exceeded a signal is sent out to sever the thread near the oversized knot to remove the defective portion. Because of this, the threads must necessarily be reknotted. The drawback of such an apparatus is, however, that only the size of the knot can be checked. This method is further insufficient when, for example, a third thread becomes knotted in causing the knot to become about 50% thicker. However, in some cases the thread cross section is such that the knot formed of three threads is smaller than the average knot formed of two threads. For these reasons an apparatus that determines only the size of the knot within a fairly sensitive range of sizes may cut out a great many knots that actually need not be removed. However, if the sensitivity of such an apparatus is reduced, then while probably less knots are cut out unnecessarily, the percentage of knots that ought to have been cut out but are not is excessive.

The present invention avoids these drawbacks by providing a method for checking knots in a traveling thread which comprises the steps of producing a first signal corresponding to a knot on a traveling thread, detecting the cross section of the traveling thread in the vicinity of the knot, producing a second signal in response to the detection of a thread cross section in excess of a predetermined measured size, detecting the simultaneous presence of the first and second signals and severing the traveling thread in the vicinity of the knot upon detection of the simultaneous presence of the first and second signals.

Further, the present invention provides an apparatus for checking knots in a traveling thread which comprises a first measuring device for producing a first signal corresponding to a knot passing therethrough, a second measuring device for detecting the cross section of the thread in the vicinity of the knot and for producing a second signal in response to the detection of a thread cross section in excess of a predetermined measured size, means responsive to the simultaneous presence of the first and second signals for delivering a third signal and means responsive to the third signal for actuating a cutting device to sever the traveling thread in the vicinity of the knot.

Accordingly, it is an object of this invention to provide a method and apparatus for detecting the presence of a knot in a traveling thread and the cross section of the thread in the vicinity of the detected knot.

It is another object of this invention to provide a method and apparatus for removing a defective knot from a traveling thread.

It is another object of this invention to provide a method and apparatus for removing a defective knot from a traveling thread upon simultaneous detection of a knot in the thread and a thread cross section in excess of a predetermined size in the vicinity of the knot.

It is another object of the invention to provide an apparatus for checking the presence of undesired knots in threads processed in textile machinery, which apparatus comprises at least one first measuring device, for example, of the electrically capacitively operating type through which a thread is passed and which produces a signal whenever a knot passes through the device, at least one second measuring device, for example, also of the electrically capacitively operating type through which the thread is passed in series relation to the passage of the thread through the first measuring device, the second measuring device producing a signal whenever the cross section of the threads passing through the second measuring device exceeds the cross section of a single thread, and a means, for example, an AND gate, connected to the measuring devices for receiving signals therefrom and adapted to be activated only when signals produced by the measuring devices are received simultaneously from the measuring devices.

It is another object of the invention to provide a method and apparatus for varying the time constant of the signal producing operations of the above apparatus whereby the time constant is reduced when thread passage is initiated and is substantially increased when a signal is produced in response to the cross section of the passing thread or in response to a passing knot.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 is a diagrammatic illustration of a measuring zone arrangement, with a thread running through;

FIG. 2 is a diagrammatic illustration of a measuring zone arrangement, with a knot running through;

FIG. 3 is a block diagram of an apparatus for the evaluation of the signals produced in the measuring zone arrangement shown in FIGS. 1 and 2;

FIG. 4 shows schematically a variant of the measurement zone arrangement;

FIG. 5 shows schematically another variant of the measuring zone arrangement; and

FIG. 6 shows a modification of the apparatus illustrated in FIG. 3.

In FIG. 1, a first measuring zone which may, for example, be formed by the electrodes of a capacitively operating measuring device 1, as generally shown in U.S. Letters Patent Nos. 3,009,101 and 3,039,051, is spaced

a short distance behind a second measuring zone formed by a second measuring device 2 with respect to the direction of travel of thread 4 therethrough. As shown, the thread 4 runs from left to right, in the direction indicated by the arrow, in passing through these measuring zones. The thread shown includes a knot 41 which has a remnant thread 42 trailing behind it such as that which occurs when the knotting apparatus either does not cut completely through the thread ends, or when a third thread is carried along in the knotting apparatus without being embodied, so that it does not become cut off with the other thread ends.

In FIG. 2 the knot 41 is shown advanced into the region of the measuring zone 1, while the remnant threads 42 is still in the effective measuring zone 2.

When a normal knot enters the measuring device 2 a signal is triggered. However, when the normal knot subsequently enters the measuring device 1 a signal is produced only by the measuring device 1, a single thread being situated in the device 2. However, if the knot drags along a remnant thread 42, then measuring device 1 as well as the device 2 will emit signals simultaneously to indicate the presence of a defective knot, because the device 2 is set to be actuated by two threads 4 and 42 when the knot 41 enters measuring device 1.

This simultaneous emission of two signals may be used, for example, for initiating the cutting of the thread in the vicinity of the defective knot.

In order to be independent of the direction in which the thread runs, the first measuring zone may be duplicated on the other side of the second measuring zone, such an arrangement being shown by FIG. 4. A defective knot is then indicated by a simultaneous signal produced by the measuring device 2 and by at least one of the measuring devices 1' and 1''.

Another way of making the apparatus independent of the direction in which the thread runs, is shown in FIG. 5. In this case, the second measuring zone is duplicated. Here, a defective knot produces a signal either at measuring device 2' or at measuring device 2'', and also at measuring device 1.

FIG. 3 shows a block diagram of one example of carrying out the invention. The two measuring devices 1, 2 form capacitive measuring systems. They may, however, sense the thread thickness by optical, magnetic, radiation-absorbing or other means, and produce corresponding signals.

High-frequency power for operating the measuring devices 1 and 2 is supplied by conventional high-frequency generators 5 and 6, respectively. It is also possible to use a single high-frequency generator in common for both measuring devices. Depending on the capacity present in the measuring devices 1, 2 (i.e., volume of the yarn portion in the measuring zone), more or less high-frequency energy is supplied to working resistances 7, 8. The voltages at these resistances are rectified in diodes 9, 10, respectively. A direct current voltage is first formed at condensers 11 and 12, through rectification of the high-frequency voltage originating from the zero capacity of the respective measuring device, i.e., the capacity of the measuring device when no thread is present therein; thereafter, upon introduction of a thread in the measuring device an additional capacity is formed, and thus an increased high-frequency voltage at the working resistances 7, 8; and finally, an additional voltage originator at the condensers 11, 12 which voltage is proportional to the quantity of thread in the respective measuring device.

In order to make the direct current voltage caused by the zero capacity and any instabilities that may occur ineffective, the DC voltage is separated through condensers 13, 14. The static zero potential reaches past resistances 15 and 16 to the input of the amplifiers 21, 22 in the conventional manner. The resistances 15 and 16 are provided with switches 23, 24 which will be explained later. The output voltages of the amplifiers 21 and 22 arrive at conventional Schmitt triggers 25 and 26, respectively. The Schmitt trigger 25 is set so that it tilts when a knot enters a measuring device 1. The Schmitt trigger 26 on the other hand is adjusted in such a way that it tilts when two threads are present in a measuring device 2. The outputs from these Schmitt triggers are conducted to the input of a conventional AND gate 30. The output of the AND gate 30 is connected to the input of an end stage 31, which, for example, actuates a thread cutting device.

In most cases continuous checking of the thread is not necessary. It suffices if an apparatus according to the present invention operates after the knotting operation. Many of the automatic spooling machines referred to at the outset have only one knotting mechanism for a number of spooling locations. Thus, checking of the knots is assured if the apparatus cooperates with the knotting mechanism in such a way that the thread is guided so that at least the knot runs through the knot-checking apparatus. The knotting and checking operation is, for example, effected as follows: seizing the two thread ends to be tied and directing the thread ends to the knotter; knotting; starting the cross spool; and passing the knot through the knot-checking apparatus.

As has been mentioned already, the condensers 13 and 14 serve to separate out the DC voltage originating from the zero capacity of the measuring devices. The time constant of the condenser 13 and of resistance 15, and of condenser 14 and of resistance 16 must on the one hand be relatively small, one second, for example, in order to permit guide stabilization, for example, when the apparatus is started; on the other hand, this time constant should be great so that the voltage at the condensers 13 and 14 does not lag unallowably from the instant of the entry of the single thread into the checking apparatus until completion of the checking operation. In order to meet these requirements, an apparatus as described below may be connected.

An additional Schmitt trigger 27, whose tilting limit is adjusted to a fairly small response range, for example 10% of the mean value of the cross section of the thread passing through the measuring zones, is connected in parallel with the Schmitt trigger 26 to tilt upon entry of a thread into the apparatus. If desired, it can be connected in parallel with the Schmitt trigger 25. Initially, in its untilted state the Schmitt trigger 27 energizes a relay 28 which includes two normally closed contacts 23 and 24. When the Schmitt trigger 27 tilts, the relay 28 is deenergized and the two contacts 23 and 24 are opened. This meets the apparently contradictory requirement of a relatively small time constant at the entry of a thread, because switches 23 and 24 are closed and an extraordinarily great time constant after entry of a thread because the switches 23 and 24 are opening. Such an arrangement, that may, for example, be termed time constant changer, can be connected ahead of or after the amplifier, or ahead of and after the amplifier, in order to separate the DC voltage originating from the zero capacity at the input to the amplifier, and in order to eliminate instabilities in the amplifier itself.

The apparatus according to the present invention can be adapted, with relatively small expenditure, to solve additional problems. Thus, for example, the size of the knot can be checked by connecting an additional Schmitt trigger 32 (FIG. 6) in parallel to the Schmitt trigger 25 whereby the tilting limit of the trigger 32 is adjusted to correspond to the permissible size of the knot and the output of the trigger 32 is connected directly to the final stage 31 for rendering the stage ineffective upon passage of a knot of permissible size.

Having thus described the invention, it is not intended that it be so limited as changes may be readily made therein without departing from the scope of the invention. Accordingly, it is intended that the subject matter described above and shown in the drawings be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A method of checking knots in a traveling thread comprising the steps of

producing a first signal corresponding to a knot in the traveling thread,

detecting the cross section of the traveling thread in the vicinity of said knot,

producing a second signal in response to the detection of a thread cross section in excess of a predetermined measured size, detecting the simultaneous presence of the said first and second signals, and

severing the traveling thread in the vicinity of said knot upon detection of the simultaneous presence of said first and second signals.

2. A method as set forth in claim 1 which further comprises the steps of detecting the size of said knot and producing a third signal in response to the detection of a knot size different from a predetermined measured size whereby the traveling thread is severed in the vicinity of said knot upon production of said third signal and one of said first and second signals.

3. An apparatus for checking knots in a traveling thread comprising

a first measuring device for producing a first signal corresponding to a knot in the traveling thread passing therethrough,

a second measuring device upstream of said first measuring device for detecting the cross section of the traveling thread in the vicinity of said knot and for producing a second signal in response to the detection of a thread cross section in excess of a predetermined measured size,

means responsive to the simultaneous presence of said first and second signals for delivering a third signal, and

means responsive to said third signal for actuating a cutting device to sever the traveling thread in the vicinity of said knot.

4. An apparatus as set forth in claim 3 wherein said means responsive to the simultaneous presence of said first and second signals comprises an AND gate, said AND gate being opened on the simultaneous presence of said first and second signals whereby the output thereof is delivered as said third signal.

5. An apparatus as set forth in claim 3 which further comprises a third measuring device upstream of said second measuring device for producing a fourth signal corresponding to a knot in the traveling thread passing therethrough whereby the traveling thread is severed upon simultaneous presence of said second signal and at least one of said first and fourth signals.

6. An apparatus as set forth in claim 3 which further comprises a third measuring device downstream of said first measuring device for detecting the cross section of the traveling thread in the vicinity of said knot and for producing a fourth signal in response to the detection of a thread cross section in excess of a predetermined measured size whereby the traveling thread is severed upon simultaneous presence of said first signal and at least one of said second and fourth signals.

7. An apparatus as set forth in claim 3 which further comprises a means for detecting the size of said knot and for producing a fourth signal in response to the detection of a knot size different from a predetermined measured size whereby the traveling thread is severed upon simultaneous presence of said fourth signal and one of said first and second signals.

8. An apparatus as set forth in claim 3 wherein said first and second measuring devices form a capacitive measuring system.

9. An apparatus as set forth in claim 8 wherein said first means and said second means each comprises a resistance-condenser element, and a time constant varying means connected to said resistance-condenser elements, said time constant varying means being capable of reducing the time constant of said resistance-condenser elements when thread passage is initiated and of substantially increasing the time constant of said resistance-condenser elements when a signal is produced by one of said first and second means.

10. An apparatus as set forth in claim 8 wherein said first and second measuring devices include a condenser in the path of each of said first and second signals, a relay having a pair of contacts, each of said contacts being disposed in a respective path of said first and second signals downstream of a respective condenser, a pair of resistances, each of said resistances being connected to a respective one of said contacts for operative connection into said respective paths of said signals, and means for triggering said relay upon entry of the traveling thread into said second measuring device whereby the time constant of said condenser and resistance are changed upon passage of a thread through said first measuring device.

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