June 4, 1968 J. E. HARRIS 3,386,145

QUALITY MONITORING SYSTEM FOR CONTINUOUSLY MOVING FILAMENTARY STRUCTURES

Filed Feb. 10, 1966

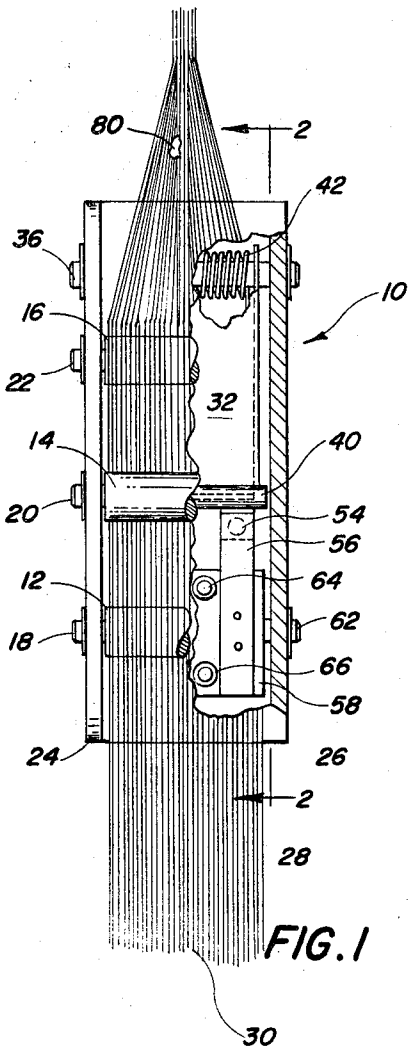


FIG. 1

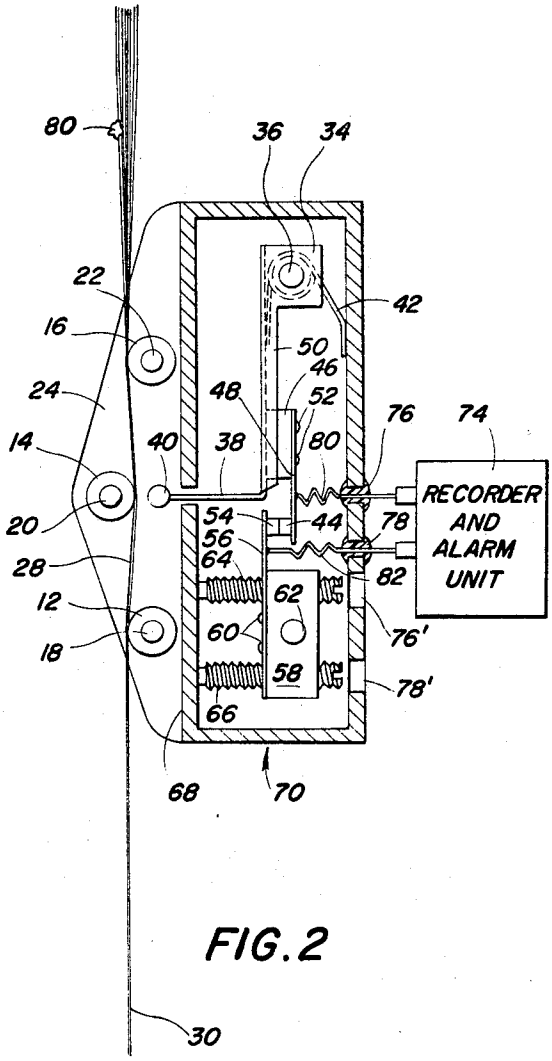


FIG. 2

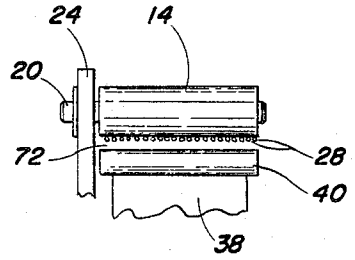


FIG. 3

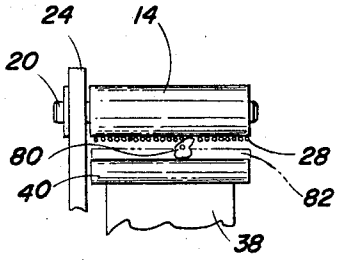


FIG. 4

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United States Patent Office 3,386,145 Patented June 4, 1968

3,386,145

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Filed Feb. 10, 1966, Ser. No. 526,434
10 Claims. (Cl. 28—64)

ABSTRACT OF THE DISCLOSURE

A filamentary monitoring device incorporating a guide arrangement that bands (i.e. spreads) a multifilament yarn-like tow into a web of side-by-side filaments while at the same time monitoring each of these filaments for irregularities of a predetermined size.

This invention relates generally to quality monitoring of continuously moving filamentary structures and, more particularly, to the in-process detection of defects and irregularities in moving threads, yarns, fibers or the like. Specifically, this invention relates to a simple, inexpensive, yet highly accurate apparatus for detecting the frequency, geometry and size of slubs or dropped filaments that occur in the spinning of synthetic fibers.

In the spinning of continuous multifilament synthetic yarn, malfunctions of the spinnerette often produce enlarged sections in the yarn filaments which are known in the yarn art as "slubs." These enlarged sections or slubs may also be produced by other malfunctions in the spinning process such as the breakage of filaments prior to or while they are being drafted. When a breakage of this type occurs, the broken filaments undergo no drafting in the spinning cabinet and thus an enlarged filament will result. Since the presence of these slubs appreciably detracts from the appearance and quality of the synthetic yarn being produced, it is extremely important to know and record when such malfunctions occur. This detection permits immediate corrective steps to be taken if such are necessary or desirable before extensive damage and losses occur.

Numerous attempts have been made in the past to cope with the detection and recording of slubs in continuously moving synthetic fibers including the use of elaborate optical systems. However, the optical detection systems heretofore proposed and tested have met with little success due to the fact that loops protruding from the surface of the synthetic fibers or yarn are detected and recorded as defects when in fact they are not considered as such.

Attempts have also been made to detect and record slub defects through the use of mechanical detector devices. For example, it has been proposed that the continuously moving yarn be passed between two finger-like bars that are biased to rest one upon the other. Since one of these bars is stationary while the other is movably mounted, any variation in the thickness of the yarn will result in a corresponding movement of the movable bar. This movement is used to produce a recording signal in a suitable mechanical or electrical transducer. Unfortunately, numerous problems are encountered with this type of design which all but prohibits its use on synthetic fibers or yarns. One of the more troublesome of these problems is that when the two bars are allowed to rest one upon the other, a pinching action occurs on the yarn that is passing therebetween which in itself damages the yarn by breaking filaments. In addition, detectors of this type are totally unable to accurately detect small slubs which may be hidden in the interior of a multifilament yarn bundle that is being analyzed. Furthermore, detectors of this and other heretofore proposed types, in general, require the use of expensive electronic circuitry if even the roughest of approximations is to be made of the signals generated by the flaw detector equipment.

Therefore, it is readily apparent that the production of a detector system which would accurately monitor the thickness of a continuously moving yarn thereby detecting and recording the occurrence of any slubs or like defects would represent a long sought after solution to a perplexing problem. According to this invention it has been found that such a detector can be produced which not only will detect the presence of slubs in a yarn, but is unaffected by protruding loops and thus will not give a "false" indication when yarn loops occur. In its simplest form, the detector device of this invention consists of a guide arrangement which spreads the multifilament yarn into a web or belt of side-by-side arranged filaments that are then passed between a thickness detector unit. The detector unit is of a mechanical make-or-break type which is operated by a movable guide mounted in juxtaposition to the web. This simple, yet highly effective thickness detector unit can be easily adjusted so that its threshold of detection is such that only slubs of a predetermined size will be detected, no yarn damage will occur, and no expensive electrical equipment for amplification and analysis of the electrical signals produced by the detector is required.

Thus, it is an object of this invention to provide a detector for quality monitoring continuously moving filamentary structures.

Another object of this invention is to provide an automatice, in-process detection of slubs or undrawn broken filaments in the spinning of synthetic continuous multifilament yarns.

Yet another object of this invention is to provide a yarn surface irregularity detector which will not produce false output signals when loopy yarn is passed therethrough.

A further object of this invention is to provide a multifilament yarn detector that will detect small surface irregularities such as slubs or undrawn broken filaments which might normally be hidden within the bundle of the yarn.

A still further object of this invention is to provide a slub detector which blooms a multifilament yarn so that surface irregularities that might otherwise be hidden are exposed for detection.

Yet another object of this invention is to provide a slub detector which is of such a design as to allow a simple mechanical threshold to be set for the analysis of slubs of a predetermined size.

An additional object of this invention relates to the manner in which the slub detector unit operates so that only surface irregularities of a predetermined size contact and thus actuate the movable detector element thereby assuring that the continuously moving filamentary structure is not subjected to additional strain or damage.

These and other objects and advantages of this invention will be more apparent upon reference to the following description, appended claims, and drawing wherein:

FIGURE 1 is a schematic plan view of a quality monitoring system of this invention with parts thereof broken away to show constructional details of the yarn irregularity detector unit;

FIGURE 2 is a longitudinal sectional view taken along the line 2—2 of FIGURE 1 showing further construction details of the detector unit; and

FIGURES 3 and 4 illustrate the operation of the threshold detection feature of this invention.

With continued reference to the accompanying figures wherein like reference numerals designate similar parts

throughout the various views, and with initial attention directed to FIGURE 1, reference numeral 10 is used to generally designate a quality monitoring system constructed in accordance with the concepts of the present invention. This quality monitoring system consists of two basic units; namely, a banding or spreading unit, and a defect detection unit.

The banding unit per se consists of at least three filament or strand guides 12–16 that are carried on rods 18–22 which are secured at their ends to the wall 24 of the monitoring system. As more clearly shown in FIGURE 2, the axis of the center filament guide 14 is mounted slightly above the plane formed by the axes of filament guides 12 and 16. This staggered positioning of the filament guides is very important and must be such that the filament 28 of a multifilament strand or yarn 30 that is to be monitored will first pass over the input guide 12, under the middle guide 14, and then over the output guide 16. Since the surface of the middle guide 14 is slightly below the surfaces of the other guides 12 and 16, the filaments 28 passing through the quality monitoring system will be placed under a slight tension that will assure that they are always maintained in contact with all the filament guides.

This passing of the filaments through the staggered and slightly overlapping filament guides is of extreme importance since it causes the multifilament strand or yarn to band (i.e. spread out) into a thin sheet or web, as more clearly shown in FIGURE 1. With the yarn thus spread out in a thin band, any defect, such as a slub or undrawn broken filament whose cross sectional diameter is larger than that of a normal filament, will protrude above the surface of the yarn band. This protrusion of the defect above the surface formed by the band of normal filaments assures that the defect will be exposed for detection.

The defect detection unit that is used to detect any flaws in the banded yarn that are above a predetermined size consists of an L shaped movable arm 32 that is pivotably mounted in a cantilevered manner at one end 34 about a pin 36. The free end 38 of the movable arm is positioned directly adjacent the middle guide 14, as shown in FIGURE 2, and acts as a support for a movable guide 40. A spring biasing unit 42, which is coiled about the pin 36, is employed for lightly urging the movable arm and thus the movable guide 40 toward the web and stationary guide 14. A first electrical contact element 44 is mounted on the movable arm 32 through the use of an insulative block 46 and an electrically conductive leaf spring support 48. The insulative block 46 is secured to the movable arm by any suitable means, such as by bent-down ears 50, while a pin or like element 52 is used to secure the leaf spring support 48 in a cantilevered manner to the block.

A second electrical contact element 54, which is also carried on a leaf spring electrically conductive support 56, is secured to an insulative block 58 in a cantilevered condition by a pin or like element 60. The insulative block 58 is in turn rotatably secured on a support pin 62 which is attached at either end to the walls 24 and 26 of the quality monitoring system. A pair of set screws 64–66, one of which is located on either side of the support pin 62, are threaded through the insulative block 58 and engage against the top 68 of the dust enclosure shield 70 that is used to protect the defect detection unit.

As will be apparent, the movement of the set screws 64 and 66 will result in the insulative block 58 being rotated around the support pin 62. This movement, in turn, is transmitted by the spring leaf support 56 to the contact 54 thereby causing it to move contact 44. Since the two electrical contacts 44 and 54 are biased into both physical and electrical engagement against one another, the movement of the contact 54 will also cause a like movement of the contact 44 as well as the movable guide 40. Thus, the threshold level of the quality monitoring system 10, as determined by the width of the slit 72 which exists between the adjacent surfaces of the fixed guide 14 and the movable guide 40, is easily adjusted by simply rotating the set screws 64 and 66.

A recorder and alarm unit 74 of any suitable type can be electrically connected to the quality monitoring unit 10 for detecting and recording the electrical output signals that are produced as a slub or other defect above a predetermined size passes between the stationary filament guide 14 and the movable guide 40. A pair of output terminals 76–78 are shown mounted through the dust enclosure 70 to facilitate the coupling of such a recorder to the monitoring unit 10. Each of these output terminals is connected through a flexible electrical conductor 80–82 to the electrical contacts 44 and 54.

The operation of the quality monitoring unit 10 can be described substantially as follows: The multifilament yarn 30 is first threaded over the filament guide 16, under the guide 14, and then over the guide 12 after which it is attached to a suitable takeup roll (not shown). Once the takeup roll is started the yarn 30 will be pulled over the filament guides 12–16 and thus spread out or banded into a flat web-like configuration. This banding process is essential, especially for the detection of smaller defects, since in unbanded yarn a defect can be hidden in the center of the yarn strand. Any defect, such as a slub or undrawn broken filament, whose cross sectional diameter is larger than that of the normal filaments will be forced to protrude from the surface of the banded yarn. The movable guide 40 can now be positioned by adjusting the set screws 64–66 through the apertures 76′ and 78′ in the enclosure 70 so as to form a slit whose width is greater than the diameter of a normal filament. By adjusting this width setting a defect size threshold can be produced that will determine the size defect which will be counted.

Once the defect size threshold has been set on the defect detector unit the normal yarn being drawn through the monitoring unit will pass undetected through the slit 72 existing between the surfaces of the filament guide 14 and movable guide 40 in substantially the manner shown in FIGURE 3. However, any protruding defect, such as shown at 80 in FIGURE 4, will force the movable guide 40 to move from its rest position, as represented by the broken line 82, thereby breaking the electrical contact which exists between the contacts 44 and 54. This separation of the electrical contacts produces an electrical output signal that can be recorded by the unit 74.

From the foregoing description it can be seen that the quality monitoring system of this invention offers numerous advantages over any other continuous in-process flow detector system heretofore available to the yarn industry. For example, the banding unit assures that even the smallest defect in a multifilament yarn will be exposed for detection and not hidden in the center of the yarn strand as has heretofore often occurred. The defect detection unit is also novel in that it allows an accurate analysis to be made of the frequency, geometry and size of flaws occurring in a yarn without the use of any elaborate external or internal equipment. Furthermore, the slit width setting is also of extreme importance since it provides a simple method for setting a defect size threshold that determines what size defect will be counted. It should also be noted that under normal conditions (with the slit width set larger than the normal filament diameter) the yarn strand is contacted by only one guide at a time. Thus, there is no pinching or pulling action to damage the yarn strand.

This invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by the United States Letters Patent is:

1. A quality monitoring system for analyzing the frequency, geometry and degree of irregularity in multifilament textile product strands comprising a plurality of strand guide members arranged in staggered relationship for banding the multifilament textile product strands into a web as the strands are fed therebetween, at least one movable guide member arranged in juxtaposition with but spaced from said web, said movable guide member being adapted to move in response to a predetermined increase in the diameter of any strand making up said web, normally closed switching means connected to said movable guide member so that movement of said guide member will open said switching means thereby producing an output signal, and means for connecting said output signal to a recorder means.

2. A quality monitoring system according to claim 1 wherein positioning means is operatively connected to said movable guide member for adjusting the distance that said movable guide member is held away from said web thereby setting the threshold response level of said quality monitoring system.

3. A quality monitoring system according to claim 2 wherein said movable guide member is supported on a cantilevered arm, said cantilevered arm being biased so as to move said movable guide member toward said web.

4. A quality monitoring system according to claim 3 wherein said normally closed switch consists of at least a first and second electrical contact, said first contact being carried on said cantilevered arm while said second electrical contact is operatively associated therewith and carried on said positioning means.

5. A quality monitoring system according to claim 4

wherein said positioning means is a movable support that is adapted for moving said second electrical contact closed to or further away from said web thereby varying the threshold response level of said quality monitoring system.

6. A quality monitoring system according to claim 5 wherein said movable support is adapted for movement about an axis substantially parallel to the plane of said web thereby causing said second electrical contact to move in an arc.

7. A quality monitoring system according to claim 5 wherein said movable mounted support is positioned by set screw means.

8. A quality monitoring system according to claim 7 wherein a fixed means is positioned on the opposite side of said web from said movable guide member for holding said web in a fixed plane relative to said movable guide member.

9. A quality monitoring system according to claim 8 wherein said fixed means is one of said plurality of strand guide members.

10. A quality monitoring system according to claim 9 wherein said plurality of strand guide members are rotatable.

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