April 9, 1968 L. T. F. BRYAN 3,376,621

DEVICES FOR DETECTING BREAKAGE OF A THREAD, MORE PARTICULARLY IN TEXTILE MACHINERY

Filed April 26, 1966 2 Sheets-Sheet 1

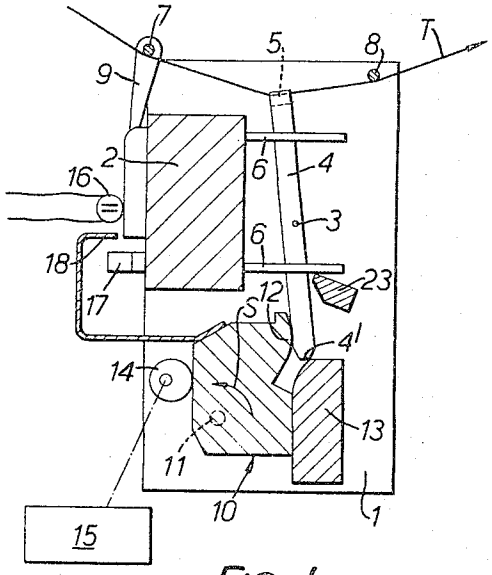

FIG. 1.

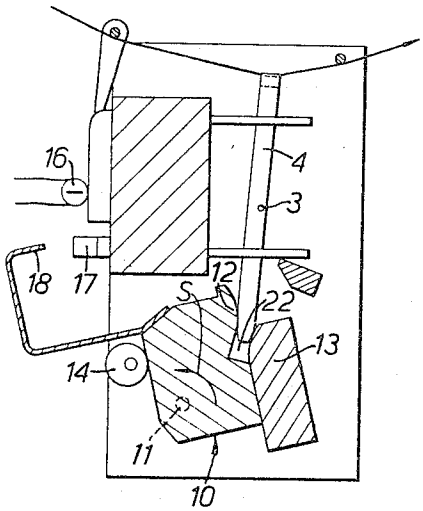

FIG. 2.

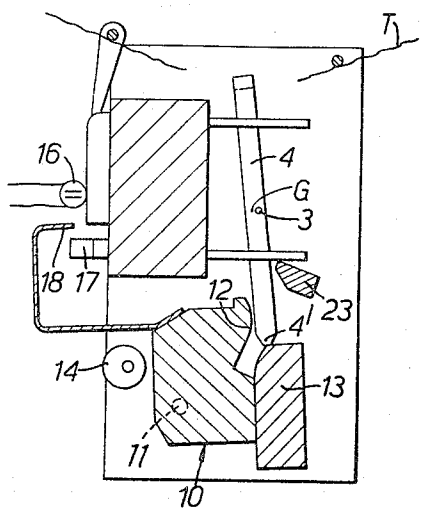

FIG. 3.

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DEVICES FOR DETECTING BREAKAGE OF A THREAD, MORE PARTICULARLY IN TEXTILE MACHINERY

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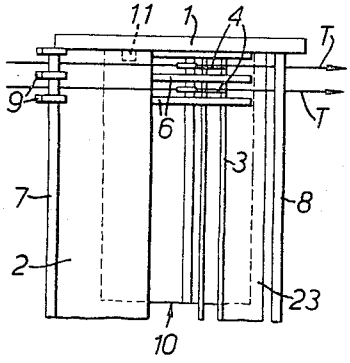

FIG. 4.

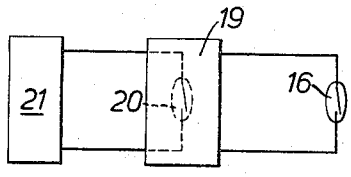

FIG. 5.

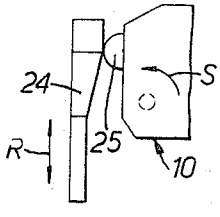

FIG. 6.

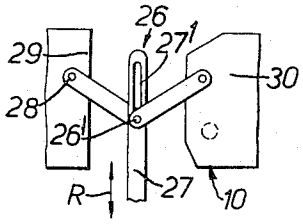

FIG. 7.

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3,376,621

DEVICES FOR DETECTING BREAKAGE OF A THREAD, MORE PARTICULARLY IN TEXTILE MACHINERY

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ABSTRACT OF THE DISCLOSURE

Apparatus for detecting thread breakage in textile or like machinery has a plurality of feelers rockably mounted on pivot means and each frictionally engaging a respective thread so as to be rocked in the direction of thread movement to an advanced position. Rocker means intermittently rocks the feelers in the opposite direction to a retarded position against the frictional action, and any feeler remaining in the retarded position due to a broken thread causes actuation of responder means associated with a control circuit of the machinery to effect a warning and/or stop motion.

The invention concerns improvements relating to apparatus for detecting breakage of thread in textile or like machinery, especially though not exclusively knitting machinery.

In particular the apparatus is for use with a plurality of threads which pass through the machinery (e.g. from the beam to the needles of a knitting machine) at the same linear speed.

In knitting machines for delicate fabric the threads are extremely fine and fragile and consequently they must be under light tension. It is therefore difficult to detect a broken thread by the loss of tension. Because of the fragile nature of the threads any apparatus for detecting breakage must not apply any substantial additional tension to the threads. The apparatus must also be compact since there is little space available to accommodate same and it is also advisable that the apparatus be capable of use with threads running at a wide variety of angles, e.g. between the beam and the needles. Again the apparatus should be easy to operate, easy to thread up and reliable in use. The apparatus may augment the normal thread tension only slightly, and such increased tension must be constant. Finally, the apparatus should function satisfactorily although the threads normally tend to vibrate (or bounce) transversely of their direction of travel.

Various forms of detecting apparatus are known, some using photo-electric means optically scanning the threads directly, which may not always be suitable or reliable especially at the selvedge regions. Other forms use mechanical feelers but are not suited to very fine threads under light tension.

An object of the invention is to provide a feeler form of apparatus which goes considerably further in meeting the requirements indicated than hitherto.

According to the invention there is provided apparatus for detecting thread breakage in textile or like machinery, comprising a plurality of feelers rockably mounted on a common pivot axis, each feeler being adapted to frictionally engage a respective thread and thereby be rocked about said axis in the direction of thread movement to an advanced position, means to intermittently rock the feelers in the opposite direction to a retarded position against such frictional action, and means responsive to any feeler remaining in the retarded position due to a broken thread to effect a visual and/or audible warning and/or stop motion of the machinery.

Advantageously each feeler presents a formation at one end to frictionally engage the respective thread, and the rocker means co-acts with the other end of the feeler.

Preferably the rocker means comprises an assembly rockably mounted on a pivot axis parallel with the feeler pivot axis and presenting a cam part to intermittently rock the feelers to the retarded position, and a stop part to lock against said other end of any feeler remaining in the retarded position due to a broken thread and so arrest the rocker means and cause actuation of the responder means.

Suitably the stop part locks against said end of each feeler with a force which is directed substantially along the feeler and through the pivot axis thereof so that an effective force is produced arresting the rocker means.

Preferably the responder means comprises a switch associated with an electrical warning and/or stop motion circuit, and any feeler remaining in the retarded position due to a broken thread causes said switch to be maintained in a condition to effect the warning and/or stop motion.

Some preferred embodiments of apparatus according to the invention are hereinafter described by way of example with reference to the accompanying drawings wherein:

FIG. 1 shows one form of the apparatus in sectional end elevation, with a feeler in retarded position with an unbroken thread,

FIG. 2 corresponds to FIG. 1 but with the feeler in advanced position,

FIG. 3 corresponds to FIG. 1 with the feeler in retarded position but with a broken thread,

FIG. 4 is a plan view of one end of the apparatus,

FIG. 5 is a block circuit diagram, and

FIGS. 6 and 7 illustrate details of alternative features of such apparatus.

The apparatus as illustrated in FIGS. 1 to 5 comprises a frame including end plates such as shown at **1** and a cross bar **2** interconnecting the plates, and a horizontal pivot pin **3** extending between the plates. A plurality of thin elongated feelers **4** are rockably mounted side by side in a substantially vertical attitude on the common pivot pin **3**. The centre of gravity G of each feeler is slightly offset rearwards from the pivot axis. The upper end of each feeler is reverted to present an inverted U-shape eye formation **5**, and a respective thread **T** moving downstream in the direction indicated is engaged in the crotch of such formation. Comb members **6** extending from the cross bar **2** keep the feelers suitably spaced along the pivot pin. The threads pass beneath a pair of rods **7** and **8** extending between the end plates and spaced respectively upstream and downstream of the feeler eye formations and slightly above the level thereof so that the threads effectively engage the feelers with a light frictional pressure. The threads are separated by fixed comb members **9** as they pass to the feelers.

Instead of the reverted eye formations **5**, the feelers may have upwardly directed U-shape ends in which event the spaced rods **7**, **8** would be slightly below the eye level to ensure the required frictional engagement.

The frictional engagement of the threads tends to rock the feelers about their pivot axis in the direction of thread movement to an advanced position as shown in FIG. 2.

A common rocker bar assembly **10** is rockably mounted on pivot means **11** with a pivot axis parallel with the feeler pivot axis, so as to co-act with the lower ends of the feelers. The assembly presents a cam part **12** engaging the feelers to intermittently rock same, in the direction opposite to the thread movement, to a retarded position as shown in FIGS. 1 and 3, against the frictional action of the thread movement. The assembly also presents a stop part **13** to lock against the lower end **4'** of any feeler remaining in the retarded position due to a broken thread and so arrest the rocker assembly, as shown in FIG. 3.

A rotary cam **14** driven at a desired constant speed such as by an electric motor indicated at **15** co-acts with the rocker assembly to effect the intermittent rocking thereof and thus of the feelers. Spring means (not shown) urges the rocker assembly in the direction S away from the feelers and into working engagement with the cam **14**.

A switch **16** fixed at the rear of the cross bar is of a reed type operated by a magnet **17** to a closed condition. A controller shield **18** is carried by the rocker assembly so as to intermittently interrupt the magnetic field to open the switch **16**. The switch **16** is incorporated in a timer circuit **19** comprising a switch **20** associated with an electric circuit **21** which is to effect a visual and/or audible warning and/or stop motion of the machinery in response to detection of a broken thread.

In normal operation, the feelers are rocked to the advanced position of FIG. 2 by the thread movement, and intermittently rocked to the retarded position of FIG. 1 by the driven cam **14** acting on the rocker assembly. During the cycle, the spring means drives the rocker assembly rearwards in direction S to maintain engagement with the cam **14**. Simultaneously the thread movement rocks feelers to advanced position, the lower ends of the feelers being accommodated in a slot space **22** between the cam and stop parts of the rocker assembly, and being urged against the cam part. The switch **16** is intermittently operated by the movement of the rocker assembly, but the timer circuit prevents such intermittent operation from affecting the warning and/or stop motion circuit.

There are at least two important and practical advantages from an apparatus according to this invention. Firstly, the feelers impose a tension on the threads of a very small order. Secondly, such variations in tension as are imposed on the threads by to-and-fro movements of the feelers is negligible because of the relatively slow and uniform nature of movement of the feelers. Because of these effects a fabric is produced from the threads which has a high degree of uniformity and is of excellent quality.

As soon as any thread breaks, as indicated in FIG. 3, there is no frictional force to rock the respective feeler from a retarded to an advanced position. That feeler therefore remains in the retarded position and the stop part **13** locks against the lower end of the feeler whereby the rocker assembly is arrested in the position shown in FIG. 3. Consequently the switch **16** is maintained in open condition, and thus through the timer circuit closes the warning and/or stop motion circuit.

The stop part **13** locks against the lower end of each feeler with a force which is directed substantially along the feeler and through the pivot axis thereof. Thus a relatively large locking force can be used ensuring positive arresting action on the rocker assembly **10**. The mentioned offset of the centre of gravity G of each feeler from its pivot axis has a biasing action tending to maintain the feeler in the retarded position. This avoids a risk that if a thread breaks vibration may rock the feeler away from the retarded position and so leave a thread breakage undetected. A fixed guard bar **23** delimits the retarded position of the feelers.

The rocker assembly may be driven in any suitable alternative manner. For example, FIG. 6 illustrates the use of a driven surface or wedge cam **24** reciprocated in direction R and co-operating with a cam follower **25** fixed to the rear of the rocker assembly, to effect the intermittent rocking of such assembly and thus of the feelers. Spring means will act in direction S as previously described. Instead of the cam being reciprocated vertically, it could be reciprocated horizontally and comprise a pin and slot mounting to translate to the desired vertical movement of the cam. FIG. 7 illustrates the use of a toggle linkage **26** with a driving link **27** reciprocated in direction R, and toggle links pivoted at **28** to a fixture **29** and at **30** to the rocker assembly, so as to intermittently

rock the assembly and thus the feelers to the retarded position. The link **27** has a slot **27'** engaging the toggle pivot **26'** to provide a lost motion arrangement so that spring means can act again as above described. Another possibility is the use of electro-magnetically driven means co-acting with the rocker assembly to intermittently rock same.

Instead of the magnetically operated responder switch **16**, any other suitable form of switch means may be controlled by the rocker means. Alternatively, photo-electric means may be used to respond if the feelers remain in the retarded position, or if the rocker assembly is arrested, to operate a switch associated with the warning and/or stop motion circuit. In another arrangement the stop part of the rocker assembly and the lower end of each feeler may constitute co-acting switch contacts to close an electrical circuit to effect the warning and/or stop motion.

Instead of the cam part of the rocker assembly providing the camming action on the feelers, this action may be accomplished directly by a suitable rotary cam, e.g., a square-section shaft, which cam will also provide the required camming action on the rocker carrying the stop part.

In one practical example, one such apparatus of the invention is used to detect thread breakage for each of the two selvedge groups of threads of a knitting machine, each apparatus being located in the respective selvedge region and preferably as close as possible to the fabrication line of the machine. Each apparatus comprises two of the end plates **1** spaced about 2 ins. apart and say 64 feelers to accommodate thread pitches up to 32 threads per inch. The drawings of the apparatus are on an enlarged scale for the sake of clarity. The threads in the main region between the selvedge groups may be optically scanned for faults by photo-electric means in known manner. Alternatively, a single apparatus of the invention and of appropriate width could be used with a feeler for every thread.

I claim:

1. Apparatus for detecting thread breakage in textile or like machinery, comprising a frame, pivot means presenting a pivot axis and located in said frame, a plurality of feelers rockably mounted on said pivot means, each feeler being adapted to frictionally engage a respective thread and thereby be rocked about said axis in the direction of thread movement to an advanced position, means to intermittently rock the feelers in the opposite direction to a retarded position against such frictional action, and means responsive to any feeler remaining in the retarded position due to a broken thread associated with a control circuit of the machinery.

2. Apparatus according to claim **1** wherein each feeler presents a formation at one end to frictionally engage the respective thread, and the rocker means co-acts with the other end of the feeler.

3. Apparatus according to claim **2** wherein the rocker means comprises an assembly rockably mounted on a pivot axis parallel with the feeler pivot axis and presenting a cam part to intermittently rock the feelers to the retarded position, and a stop part to lock against said other end of any feeler remaining in the retarded position due to a broken thread and so arrest the rocker means and cause actuation of the responder means.

4. Apparatus according to claim **3** wherein the stop part locks against said end of each feeler with a force which is directed substantially along the feeler and through the pivot axis thereof, so as to avoid any substantial variation in thread tension.

5. Apparatus according to claim **3** wherein the rocker means comprises a driven means co-acting with said rocker assembly to intermittently rock the feelers to the retarded position, and spring means urging the rocker assembly in a direction away from the feelers and into working engagement with said driven means.

6. Apparatus according to claim 5 wherein said driven means comprises a cam.

7. Apparatus according to claim 5 wherein said driven means comprises a toggle drive linkage.

8. Apparatus according to claim 1 wherein the feelers are mounted substantially vertically on a horizontal pivot, and the centre of gravity of each feeler is slightly offset from the pivot axis to tend to maintain the feeler in the retarded position.

9. Apparatus according to claim 1 wherein the responder means comprises a switch associated with an electrical control circuit, and any feeler remaining in the retarded position due to a broken thread causes said switch to be maintained in a condition to effect the control.

10. Apparatus according to claim 9 wherein the rocker means comprises a controller causing said switch to be

maintained in a condition to effect the control when any feeler remains in the retarded position and thereby arrests the rocker means.

11. Apparatus according to claim 10 wherein said switch is a magnetically operated switch.

12. Apparatus according to claim 9 wherein said switch is incorporated in a timer circuit adapted to effect the control when said switch is maintained in the appropriate condition.

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