May 17, 1960 H. F. BLACKBURN ET AL 2,936,602

APPARATUS FOR DETECTING FLAWS IN KNITTED CLOTH

Filed Jan. 6, 1958 2 Sheets-Sheet 1

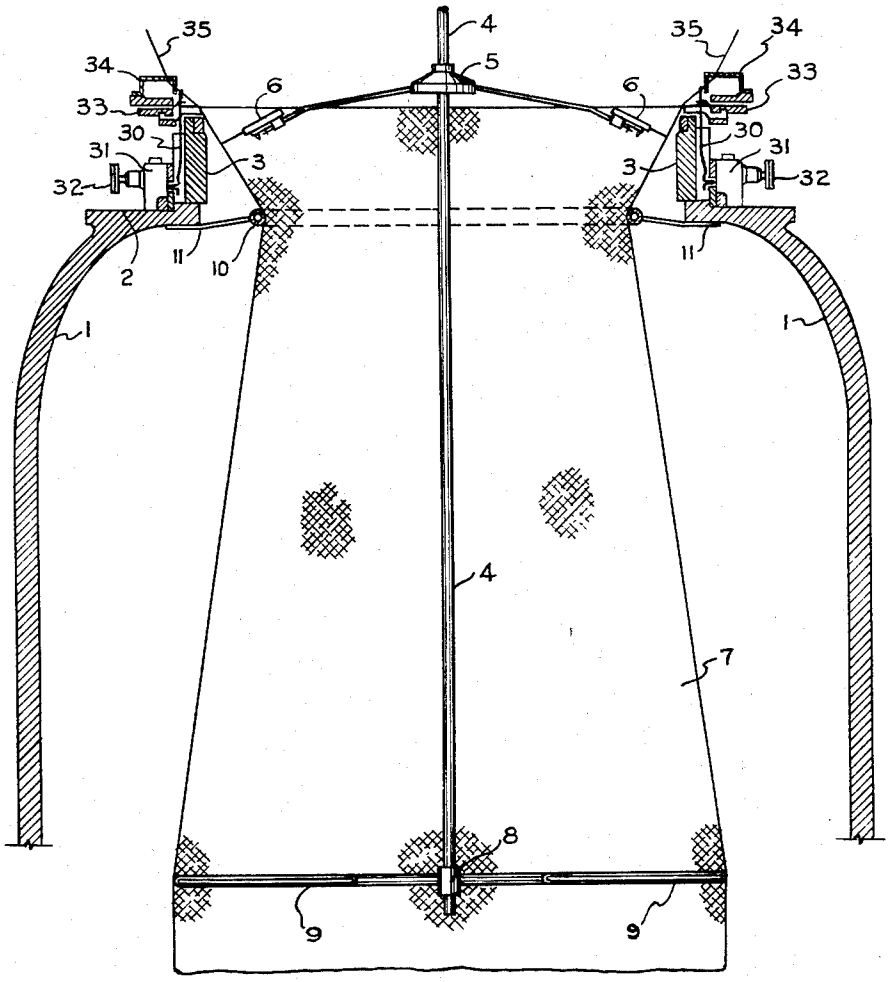


Fig. 1

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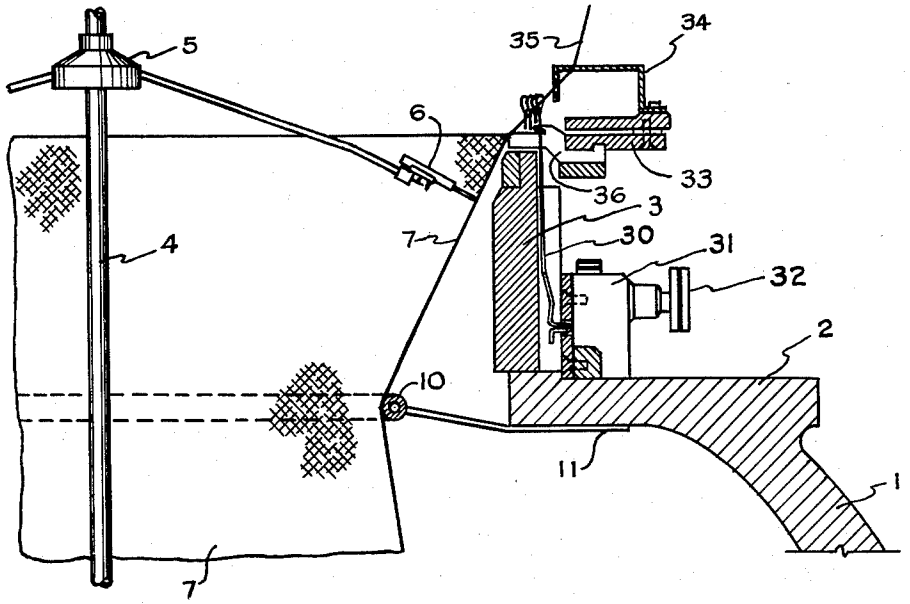


Fig. 2

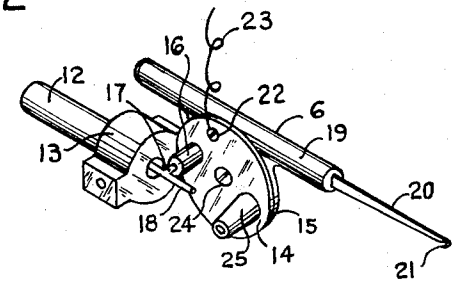


Fig. 3

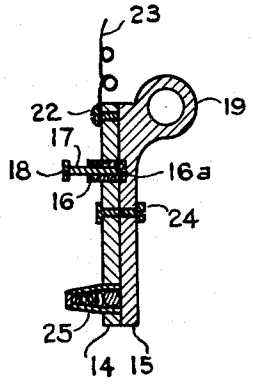


Fig. 5

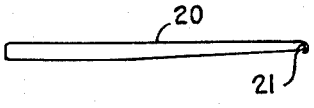


Fig. 4

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2,936,602

APPARATUS FOR DETECTING FLAWS IN KNITTED CLOTH

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Application January 6, 1958, Serial No. 707,407

4 Claims. (Cl. 66—166)

This invention relates to an automatic means for stopping the motion of a circular type knitting machine, and it deals more particularly with an apparatus and method for detecting a flaw in the knitted cloth, such as a dropped stitch, hole, rent, or tear, but more specifically the smallest defect, including a run, and responsive to stop the motion of the machine.

The invention relates more particularly to that type of machine which knits a tubular web of fabric which may descend or rise from the knitting head with the web moving or rotating axially with respect to the head during the motion of the machine.

We are well aware of the many variations in stop-motion or detector devices in use with this type of machine; most of which comprise a plurality of feeler needles which co-act with the lateral movement of the cloth, thereby moving the feeler to complete an electrical circuit and stop the motion of the machine.

Some of these foregoing types of stop-motion are defined as in the patent to A. Crawford et al., U.S. 2,571,211 or in the patent to M. Antonevich, U.S. 2,643,534, which are designed to detect holes, drop stitches, runs and the like. However, we have found that while these devices may detect sizable tears, rents or holes in the knitted web, and more particularly are they operable with rib-type cloth, they do not deal effectively with the problem of the immediate detection of very small runs in the flat-type, knitted cloth, specifically in jersey, such as may occur with a broken needle, or thread, or a dropped stitch.

As the knitted tube comes off of the knitting needles, or cylinder comprising the head of this type of machine, the warp is very close together, and the tubular web is hanging somewhat loosely before being taken up by the draw bar or rolls on which the material is wound. This situation is changed somewhat before the cloth is rolled, in many machines, by the use of an inside spreader, which stretches and tensions the cloth outwardly as it is wound on the take up. However, where the feeler-needle type stop-motion is located adjacent to this knitting cylinder and is pressing outwardly against the web there is generally a constant variation in pressure of the detector needle against the surface of the cloth, and no application of artificial tension against the needle point in such manner as to maintain even pressure and force the detector into a run which may be concealed in the warp of the cloth.

We have found that for the detection of small runs, as opposed to larger openings and tears, it is necessary, particularly on the fine knit of jersey type cloth, to force, under pressure, the head of the feeler-needle to enter these runs, in order to actuate the stop-motion devices which are presently available embodying a laterally displaceable type needle.

Therefore it is a primary object of this invention to provide an apparatus and method, for use in connection with the laterally displaceable, feeler-needle type, stop-motion, in a circular knitting machine, whereby the web

of cloth may be kept in constant tension and pressure against the feeler needle, thereby to force it to detect small runs of the character described.

It is a further object of the invention to provide for the detection, by such means, of runs in a knitted web immediately adjacent the knitting head of a machine.

Accordingly, a salient feature of the invention is to provide, in combination with the location of a feeler-needle detector immediately adjacent to the knitting cylinder, a means for constantly tensioning the cloth against the head of the needle, such that the detector is forced to enter the interstices of a small run in the fabric.

Since the embodiment of our invention may be used by attachment of the apparatus adjacent the heads of cylindrical knitting machines of the basic type, which may vary somewhat in specific over-all structure, without departure from the invention, we have chosen to disclose an embodiment by means of a diagrammatic illustration of the pertinent portion of the head of a basic type knitting machine in connection with the use of a well-known, standard type of stop-motion feeler device.

In the accompanying drawings, which form a part of the instant specification, in which like numerals are used to indicate like parts in the various views, and are to be read in conjunction therewith:

Fig. 1 is an elevational view of the head of a circular type knitting machine, shown partially cut away in section, with the knitted cloth flowing from the knitting cylinder partially cut away to afford a view of the position of the stop-motion feeler needles and tension member.

Fig. 2 is a diagrammatic elevation of the head of the machine of Fig. 1, in section to show the positioning of the stop-motion feeler needle and tension member.

Fig. 3 is an enlarged perspective view of a standard type stop-motion feeler needle modified.

Fig. 4 is an elevation of the modified needle of Fig. 3.

Fig. 5 is a sectional view taken through Fig. 3.

Referring more particularly to the drawings in Figs. 1 and 2, there is diagrammatically shown therein a circular type knitting machine, having a housing **1** provided with a head **2** molded with a knitting cylinder **3**, which supports a sinker-carrier ring assembly **33**. Also supported and carried by the cylinder **3** is the usual plurality of knitting needles **30**, which in this type of machine are arranged around the periphery of the cylinder, reciprocal vertically in alternate series by means of a cam assembly **31** regulated by knobs **32**. The needles **30** each clasp an influent thread **35** supported by a guide **34**, are cammed downwardly until the looped ends are knitted together and released by the sinker **36**, thus forming knitted cloth in the usual manner. The illustrative arrangement shown is that of a "Supreme" type machine as known in the industry.

Coaxial with the knitting cylinder there is disposed a vertical shaft **4** which supports a collar **5** carrying thereon a plurality of radially disposed stop-motion feeler attachments **6**.

Flowing from the needles which knit the material is a web of knitted cloth **7**, partially cut away to show the structure which is the subject of our invention.

As can be seen from the drawings the shaft **4** supports at its lower end a collar **8** having laterally disposed loops of metal **9** which spread the knitted cloth before it is taken off in normal operation by draw bars and rolls.

An improvement, as part of our invention resides in an O-ring **10** which is attached by means of lateral braces **11** in the embodiment shown to the knitting cylinder as illustrated. The braces **11** can be fixed by screws, or welded to both the ring and the knitting cylinder. For convenience we used screws for the attachment of the braces to the cylinder and welded the same to the ring. The O-ring **10** is constructed of such size in diameter that it

tensions the cloth immediately as indicated so that the web is forced under tension against the tips of the stop-motion feeler attachments **6**.

While it can be seen in the illustrated embodiment that we have indicated a perfect circle in the O-ring, this need not be absolutely circular in configuration. The object is to inwardly tension the cloth against the head of the needle of the stop-motion in this embodiment. It can be seen that a form of abutment from the sides of the cylinder, projecting inwardly therefrom, with this configuration to allow the passage of the web and cause the same to be tensioned against the feeler needle would also be operable. At the same time, the O-ring could be in the form of a flattened bar, or the like; but we use the ring here to afford free sliding surfaces for the cloth.

It is essential for proper operation that the tensioning member be disposed between the feeler-needle stop-motion, which we shall describe below, and the point where the cloth is taken upon the draw bars or rolls; and we have found it to be necessary that the stop-motion be disposed immediately adjacent the knitting cylinder, with the tension member therefore immediately adjacent to the stop-motion, as shown, to afford the maximum amount of tension against the needle. This would also be true if the web were being knitted and drawn inwardly at some distance from the head of the machine, rather than being spread, as shown, before being taken up.

It should be noted that in this type of knitting machine, a sinker ring is located atop of the machine, and coacts with the knitting needles on the knitting cylinder to knit the cloth. In the knitting operation with this type of machine, the cloth, as it flows from the knitting cylinder rotates axially with the machine, passing constantly under the surface of the feeler needles.

Accordingly, for the sake of illustration, we have shown in use a type of stop-motion feeler needle known in the trade by the name of "Wesco" covered by U.S. Patent No. 2,357,712. There are other laterally displaceable type stop-motion needles with which the invention could be applied. Referring more particularly to Figs. 3, 4, and 5 of the drawings, it can be seen that the stop-motion comprises essentially a hollow shaft **12** carrying a collar **13** which supports a circular cast prong base comprised of a lower disc **14**, welded to the collar **13**, and an upper disc **15** pivotally mounted on **14** by means of screw **24**. The disc **14** is provided with an insulating bushing **16** which supports a contact pin **17** which is in contact with a flat spring contact leaf **18** carried by shaft **12**.

The upper disc **15** has a molded prong **19** which carries a needle **20**. In the embodiment of our invention we have provided the needle **20** with a hook **21**, as shown in Fig. 4, for better action. The hook in operation is opposed to the direction of rotation of the cloth. The upper disc also carries an insulative plaster plug **16**–*a* recessed in the disc and aligned over the tip of contact pin **17**, as shown, when the mechanism is in the cocked position.

The lower disc **14** has a screw **22** in contact with disc **15** having affixed thereto a lead wire **23**. Carried in the disc is also a spring-ball assembly **25** urged against disc **15** and maintaining the mechanism in the cocked position with contact pin **17** insulated from disc **15** by plug **16**–*a*.

In operation, this type of stop-motion acts as follows: with the web of cloth rotating in knitting opposed to the projecting feeler needle **20** with hook **21**, the action of needle **20** in catching in an aperture or flaw in the cloth of sufficient size displaces the needle and prong **19** by rotating the upper disc **15**. This moves the insulating plug **16**–*a* off of pin **17** allowing it to contact disc **15**. Thus, through contact **18**, pin **17**, disc **15** and lead wire **23** a circuit is completed through shaft **12**, actuating mechanism to shut off the machine. This is a common type of stop-motion, and for clarity we have illustrated this much without showing electrical circuits, for this does not form a part of our invention.

The use of this type or similar stop-motion feeler needles, without the embodiment of our invention, does not result in the desired efficiency in stopping the knitting operation where the aperture or flaw in the cloth is other than a tear or hole of some considerable size. Rents or tears in the material of large size are readily caught by the needle and actuate the stop-motion in devices presently in use. However, the knitting of jersey produces a web of cloth in which the warp or wale as it is known in knitting is very close as it comes off of the knitting cylinder. Even with the downward pull of the cloth and subsequent spread of the material below by an inside spreader the warp or wale is likely to hang loosely or in small folds. In such case, a run, caused by a broken needle, or dropped stitch or the like, as opposed to a hole or tear, with the close hanging warp of the cloth, is concealed and masked from the usual stop-motion needle.

The use of our invention causes the web to be tensioned firmly against the end of the needle, and forces the needle to pick up the run, engaging it, and displace the needle, stopping the machine. We place the stop-motion as close to the knitting cylinder as practicable, and below insert our tensioning member to tension the cloth inwardly, as shown, against the needle, as close to the knitting cylinder as possible.

In the past, without the use of this invention, and using the stop-motion devices available at this time, we have experienced runs in knitted cloth up to eighty yards in length without detection. With the present invention, according to the spacing of the feeler needles, the average run will amount to less than two or three inches, as such has been proven by extensive experiment.

In a unit operation experiment with machines not equipped with the present invention, we have found a material loss in excess of 5%, due to runs; while, with the present invention, this loss has been cut to a negligible figure approximately 1% in jersey production.

It is apparent that the tensioning member, or O-ring, need not be mounted directly on the head, so long as it is mounted in such manner as to be disposed in the embodiment directly below the stop-motion in the relation shown with the knitting head. Such an O-ring could be mounted supported by vertical braces on the floor in such manner that it would be disposed in the desired position; the same being true of a bar or other similar abutment.

It can be seen that the method of our invention which comprises in the embodiment the mounting of the stop-motion closely adjacent the knitting cylinder, and immediately adjacent thereto the interposition of a tensioning member adapted to tension the cloth against the head of the feeler of the stop-motion, and the apparatus of our invention shown for accomplishing this end, as illustrative thereof, is the arrangement most suited for the detection of small runs or defects as well as larger flaws in the knitted cloth, and has the many advantages discussed. It is, at once, economical, simple in design, and most efficient in operation.

From the foregoing it will be seen that the invention is well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features of and subcombinations of the invention are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments of the invention may be made without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. In a circular knitting machine of the type having a knitting cylinder adapted to have a knitted tube of cloth withdrawn therefrom, means for spreading said tube comprising an inside spreading element disposed axially displaced from the cylinder, means for withdrawing the cloth over said spreading element, and a laterally displaceable feeler needle stop-motion in contact with the inner surface of the tube of cloth and disposed between said cylinder and the spreading element, the improvement which comprises means for causing said feeler needle to engage a run in the web including an annular member encompassing said tube and in contact therewith disposed between the feeler needle and spreading element constricting the tube inwardly and tensioning the same against the feeler needle.

2. An apparatus as described in claim 1 wherein said annular member is affixed to the knitting cylinder.

3. An apparatus as described in claim 1 wherein said knitting machine has a plurality of said feeler needle stop-motion elements circumferentially arranged in spaced relation.

4. In a circular knitting machine of the type having a knitting cylinder adapted to have a knitted tube of cloth withdrawn therefrom, means for spreading said tube comprising an inside spreading element disposed axially displaced from the cylinder, means for withdrawing the cloth over said spreading element, and circumferentially spaced laterally displaceable feeler needle stop-motion elements in contact with the inner surface of the tube of cloth and disposed between said cylinder and the spreading element, the improvement which comprises means for causing a feeler needle to engage a run in the web including a ring member encompassing the outer surface of said tube and in contact therewith disposed between the feeler needles and the spreading element constricting the tube inwardly and tensioning the same against the feeler needles.

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