

United States Patent

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[54] **YARN TENSION CONTROL MEANS FOR WARP-KNITTING MACHINE**
 7 Claims, 4 Drawing Figs.

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66/146
 [51] Int. Cl..... **D04b 27/14**
 [50] Field of Search..... **66/86, 86**
A, 146

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ABSTRACT: A compensator for the knitting of yarn in warp knitting machines in which one or more springs are anchored at one of their ends to a movable support and in turn support a tension roll at their other ends. The tension roll is yieldable against the bias of the springs in response to increase in tension of yarn trained around the roll. Actuating means are operated in timed relation with the knitting needles to move the support in a manner which moves the tension roll in a direction for releasing yarn to the knitting needles during peak yarn consumption and in a direction for taking up slack yarn during periods of little or no consumption, the relative positions of the springs and tension roll remaining the same with respect to the support so that the stress on the springs remains the same for a given yarn tension.

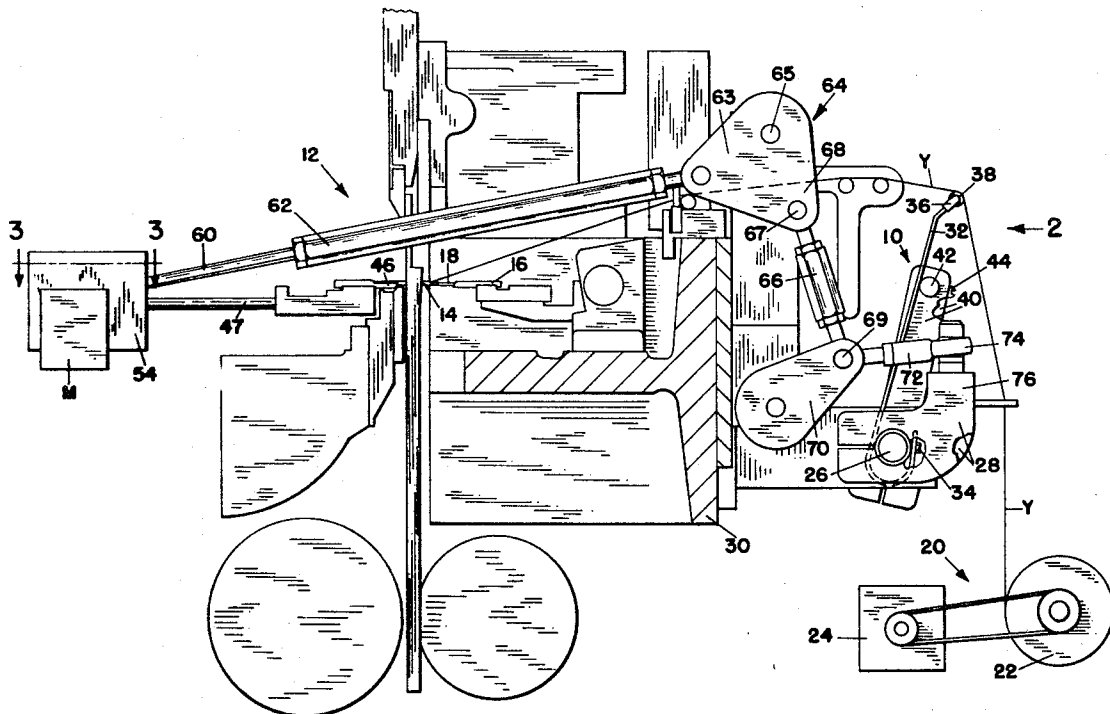


FIG. 2

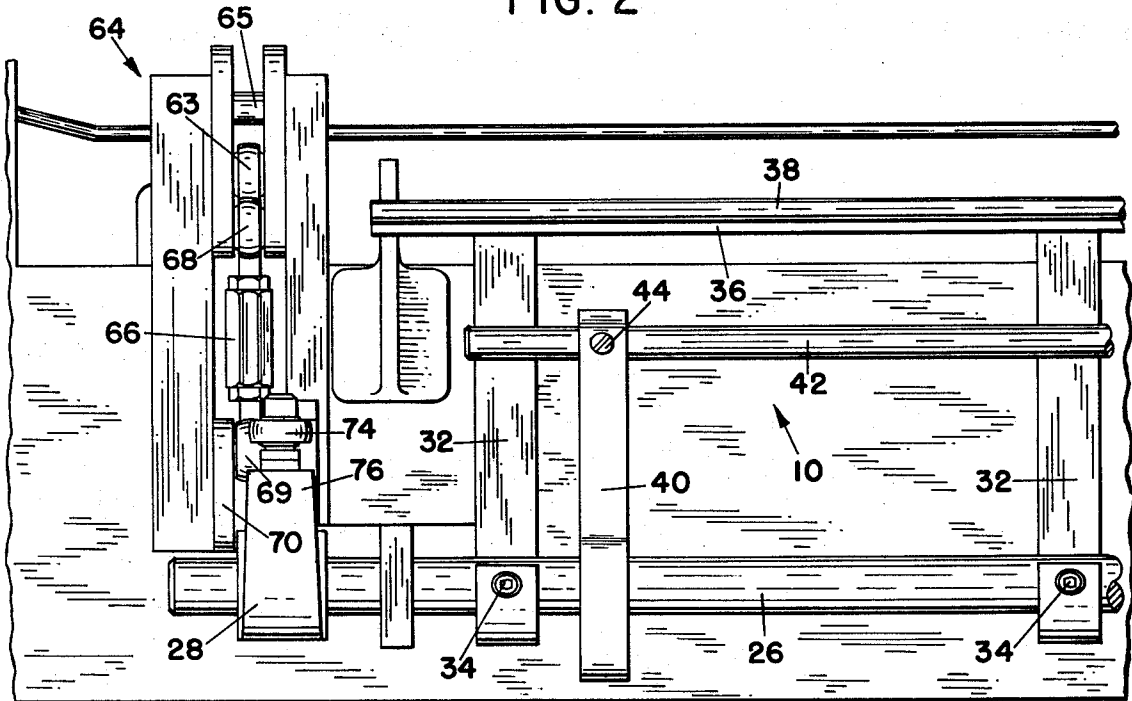


FIG. 3

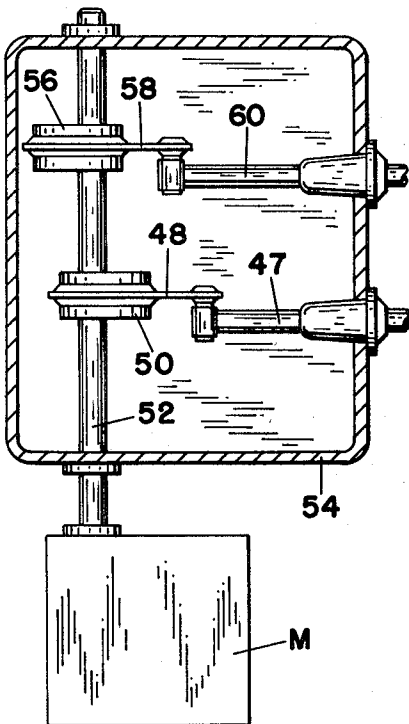
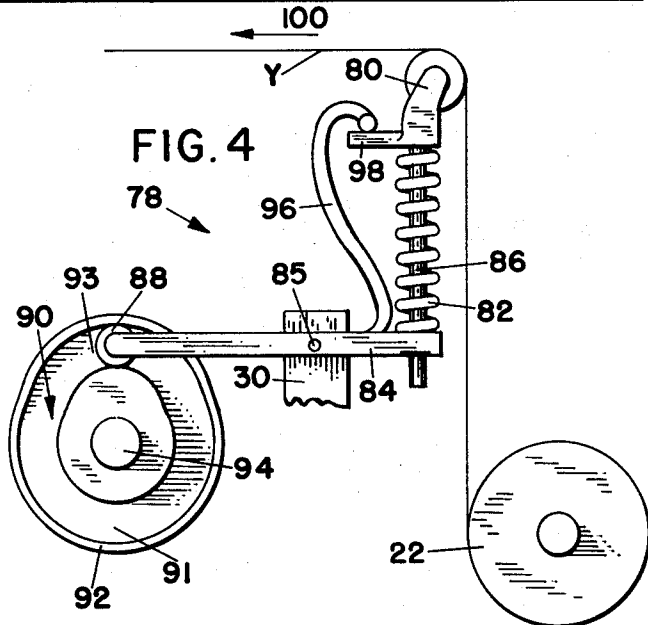


FIG. 4



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YARN TENSION CONTROL MEANS FOR WARP-KNITTING MACHINE

BACKGROUND OF THE INVENTION

The invention relates to tension control in warp knitting machines and is directed particularly to means for compensating for the variability of knitting yarn consumption during each knitting cycle.

In warp knitting machines, a row of knitting needles are reciprocated to form knitted stitches from yarns fed by yarn guides, one for each yarn. In each knitting cycle, the yarn guides are given a motion to wrap their respective yarns around individual needles. Due to the motion of the yarn guides and of the needles, a fluctuating demand for the yarn is created in each knitting cycle. Yarn is supplied to the guides from supply beams which, from a practical standpoint, must be rotated at a substantially uniform speed throughout each knitting cycle. To compensate for the difference between yarn feed and yarn consumption, it is customary to employ a tension device over which the yarn is trained as it passes from the supply beam to the guides. Conventionally, such tension devices comprise a rail or roll so constructed as to yield under spring tension upon the pull of the yarns when the demand for yarn increases and to relax and still apply tension to the yarns when the demand eases. An example of a tension device of this type is shown in U.S. Pat. No. 3,412,583 to R. H. Haehnel.

In many instances the tension devices employed in warp knitting machines do not react fast enough for high knitting speeds. In such instances, mechanical assist means are used to positively overcome the spring tension and move the tension roll, around which the yarn is trained, in a direction to release yarn to the knitting needles. By overcoming the spring, it becomes increasingly stressed so that if additional yarn is needed for loop formation, it will require considerable yarn tension to overcome the spring. Subjecting yarns to abnormal stresses is to be avoided particularly with certain types of yarns such as those made from glass fiber.

One solution to the above problem is a tension roll arrangement wherein the tension exerted against the yarn is kept constant. U.S. Pat. No. 2,327,747 to Sirmay shows a unique arrangement whereby a spring bears against a pivoted tension roll control lever in such a way that as the spring is compressed, it bears against the lever at an increasing distance from the pivot. The ratios are such that the force exerted on the yarn remain constant. In many instances, however, a slight increase in tension is desirable to prevent an excess of yarn from being drawn by the knitting needles so that uniformity of loop size can be maintained.

Another solution to the problem of yarn tension control is the use of a "duplex" system, wherein the compensating and tension control functions are divided into two units. One unit includes a rod under resilient control to take care of slight fluctuations in yarn tension. The other unit is under positive control to compensate for differences in yarn consumption. U.S. Pat. No. 2,521,218 to C. A. Hepp is an example of a "duplex" system.

SUMMARY OF THE INVENTION

It is a principal object of the invention to provide a unitary tension control means which overcomes all of the above problems.

The control means of the present invention compensates for nonuniformity of yarn consumption by releasing yarn to the knitting needles during peak consumption and taking up slack yarn during the portion of each knitting cycle where yarn is not consumed. Positive means are employed to move a tension roll around which the yarn is trained. Although the tension roll operates against a spring means in response to yarn tension, the stress on the spring is not increased when the roll is moved to release yarn to the knitting needles. This is possible because the tension roll is supported by the spring means which is in turn supported by a movable support means. Mechanical

means are employed to move the support means in timed relation to the knitting needles. Since the support, spring and tension roll are moved as a unit, there is not change in stress on the spring as would be the case if the spring were moved relative to the support means. Therefore, if the yarn pulls on the tension roll in either position, yarn releasing or slack takeup, the resistance of the roll will be the same against the spring. The stress on the spring for a given yarn tension will be the same while the tension roll is in either position.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood upon reading of the following detailed description in conjunction with the accompanying drawings in which:

FIG. 1 is a side elevation of the invention as applied to a warp knitting machine, parts being in section;

FIG. 2 is a fragmentary rear elevation looking in the direction of arrow 2 in FIG. 1;

FIG. 3 is a fragmentary section on line 3-3 of FIG. 1, showing a portion of the drive assembly; and

FIG. 4 is a diagrammatic view illustrating a modification of the invention.

Referring particularly to FIGS. 1 and 2, the preferred yarn compensator and tensioning device of the present invention is generally indicated at 10. This unit is applied to a knitting machine generally indicated at 12 and comprising a row of knitting needles 14 and a guide bar 16 which supports a plurality of guides 18. A knitting yarn supply source generally indicated at 20 supplies a sheet of yarns, indicated at y, to the guides 18. The guides wrap their respective yarns around corresponding knitting needles 14 in a well-known manner.

Supply source 20 includes a yarn beam 22 which is driven in a well-known manner as, for example, a variable speed transmitter indicated at 24 to supply yarn at a constant rate.

Compensator 10 comprises a shaft 26 pass supported at its ends in bearings 28 which are supported by the knitting machine framework indicated at 30. A series of spaced leaf springs 32 are anchored to shaft 26 by fasteners 34 at points located between bearings 28. The number of springs can be varied if different yarn tensions are desired particularly if a different type of yarn is used. The upper ends of the leaf springs 32 support an elongated tension member 36 which has a rounded surface 38 around which the yarns are trained as they pass from the beam 22 to the yarn guides 18.

A pair of upright bars 40 are fixed to shaft 26 near the ends of the shaft. A bumper bar 42 extends through the upper ends of bars 40 and is fixed thereto by screws 44. Bar 42 is situated just behind and engaging springs 32 for a purpose to be described.

The needles are mounted in a needle bar 46 which is actuated by a connecting rod 47 extending from an eccentric rod 48, see FIG. 3, which is reciprocated by an eccentric 50. This eccentric is mounted on a shaft 52 mounted in a housing 54 and which is driven by a motor M.

A second eccentric 56 is also mounted on shaft 52 and drives an eccentric rod 58. A connecting rod 60 extends from rod 58 and is connected to a first connecting arm 62. Other operating units may also be driven from shaft 52. Rod 62 is pivotally connected to one arm 63 a bellcrank lever 64 which is pivoted at 65 to frame 30. The upper end of a vertically disposed second connecting arm 66 is pivotally connected at 67 to the other arm 68 of bellcrank lever 64. The lower end of connecting arm 66 is pivotally connected by a pin 69 to a lever 70 which is also pivoted on frame 30. A horizontally disposed third connecting arm 72 is pivotally connected to lever 70 and rod 66 by pin 69. Arm 72 is connected to a universal joint 74 which is connected to the upper portion of an arm 76 which is an integral portion of one of the bearings 28. A similar series of connectors and levers extending from another eccentric on shaft 6 is connected to the other bearing 28.

During operation of the machine, eccentric 50 reciprocates needle bar 46, as well-known in the knitting art. Eccentric 56

reciprocates connecting arm 62 left and right as shown in FIG. 1 so that it oscillates lever 64 around pivot 65. Arm 62 is shown in its left-hand position as viewed in FIG. 1. When rod 62 moves to its right-hand position, lever 64 is rocked counterclockwise so that pivot 67 moves upwardly and lifts connector 66. When connector 66 is thus lifted, lever 70 is rocked counterclockwise and connecting arm 72 is pulled to the left in FIG. 1. Bearing 28 together with shaft 26 is rocked counterclockwise by the leftward pull of connecting arm 72. Since upright bar 40 is fixed to shaft 26, it will also be rocked counterclockwise so that bumper bar 42 will strike the leaf springs 32 and assist tension member 36 in its counterclockwise motion. Tension member 36 will, of course, be moved by the shaft 26 since the springs 32 are fixed to the shaft. Bumper bar 42 merely assists the movement of the leaf springs 32 to prevent whiplash which would occur at high operating speeds.

When the knitting needles are in the full line or front position, tension member 36 is in its right-hand position as shown in FIG. 1. At this point in the knitting cycle, yarn is not being consumed by the knitting needles but as the needles move toward the left in FIG. 1, they begin to draw yarn to form the next knitting loop. It is at this point when there is the greatest demand for yarn. The timing of eccentric 56 together with the particular arrangements or rods and levers and connectors which rock shaft 26, produce a motion for tension member 36 which releases yarn to the knitting needles at an ideal rate. Since the support for the springs (shaft 26) is moved positively, the stress on the springs is not increased. This means that any fluctuation in yarn tension will cause the yarn to react against a spring tension which is as "soft" when member 36 is in either of its positions.

When the knitting needles move to the right as viewed in FIG. 1, they no longer draw yarn, although the letoff continues to supply yarn at a uniform rate. To prevent the yarn from becoming slack during this phase of the knitting cycle, the tension member 36 is moved to the right, thereby "taking up" the excess yarn.

Referring to FIG. 4, there is shown a modification of the invention indicated generally at 78. This modification comprises a tension member 80 supported on a compression spring 82 which is in turn supported on one end of a lever 84. A guide rod 86 is attached to the tension member and extends freely through the spring 82 and lever 84.

Lever 84 is pivoted at 85 to the frame 30 and has a follower 88 attached to its other end. Follower 88 rides in a groove generally indicated at 90 in a cam 92. This cam is rotated by a drive shaft 94 which may be driven from shaft 52 or from the motor M in timed relation with the knitting needles. Cam 92 has a low portion 91 and a high portion 93 and is designed to operate lever 84 so as to impart a vertical motion to tension member 80 which releases and takes up yarn Y in a manner similar to tension member 36. An arm 96 extends from lever 84 and engages a projection 98 on tension member 80. Arm 96 is comparable to bumper 42 in that it positively assists member 80 to move downwardly when the right-hand end of lever 84, as shown in FIG. 4, is moved downwardly.

As in FIG. 1, yarn Y in FIG. 4 is let off from beam 22 at a constant rate and fed over tension member to the knitting needles in the direction of arrow 100. When the knitting needles are drawing yarn, follower 88 moves from the low portion 91 to the high portion 93 of cam 92. Lever 84 is rocked clockwise, thereby lowering tension member 80 as assisted by member 96. Lowering of tension member 80 allows yarn to be released to the knitting needles. During the period when the knitting needles are not drawing yarn, cam 92 moves lever 84 counterclockwise to raise tension member 80 to take up slack yarn which tends to develop from the constant feed of beam 22. As was the case in the preferred form of the invention, the stress on the spring 82 remains the same for a given yarn ten-

sion when the tension member 80 is in either of its extreme positions.

Having now described the invention, it should be apparent that other mechanical arrangements may be used to move a spring which supports a tension member without departing from the scope of the invention.

What I claim is:

1. In a warp knitting machine having means for supplying a sheet of yarns, yarn guides and reciprocating knitting needles, a compensator and tensioning device for variability of yarn consumption comprising:

- a. a supporting member, independent of said yarn guides, movable between first and second positions;
- b. at least one spring anchored at one end to said supporting member;
- c. an elongated member yieldably supported by the other end of said spring in a first position for engaging and tensioning said knitting yarn sheet wherein said tension member is displaced against the bias of said spring in response to variation in yarn tension, said tension member being displaceable to a second position when said supporting member is moved from its said first position to its said second position, the stress on said spring being substantially the same in said first and second positions of said members for a given yarn tension; and
- d. actuating means operated in timed relation with said knitting needles for moving said supporting member to one of said positions for releasing yarn to said knitting needles when yarn is being consumed by said needles and to the other of said positions for taking up slack yarn when yarn is not being consumed by said knitting needles.

2. The warp knitting machine as described in claim 1 wherein said spring is a leaf spring and said supporting member is a pivoted shaft which is oscillated by said actuating means.

3. The warp knitting machine as described in claim 2 wherein said supporting member has an extending portion for loosely engaging said leaf spring and assisting displacement of said tension member during oscillation of said pivoted shaft.

4. The warp knitting machine as described in claim 1 wherein said spring is a compression spring and said supporting member is a pivoted lever.

5. The warp knitting machine as described in claim 4 wherein said supporting member has an extending portion for loosely engaging said compression spring and assisting displacement of said tension member during oscillation of said pivoted lever.

6. The warp knitting machine as described in claim 1 wherein said actuating means comprises:

- a. a constantly rotating eccentric member; and
- b. linkage means connecting said eccentric member to said supporting member.

7. The warp knitting machine as described in claim 6 wherein said linkage means comprises:

- a. a first connecting arm connected at one end to said eccentric member;
- b. a bellcrank lever pivotally mounted on a fixed pivot, one arm of said bellcrank lever being pivotally connected to the other end of said first connecting arm;
- c. a second connecting arm pivotally connected at one end to the other arm of said bellcrank lever;
- d. a second lever pivotally mounted on a fixed pivot and being pivotally connected to the other end of said second connecting arm at a point spaced from the fixed pivot of said second lever;
- e. a third connecting arm, one end of which is pivotally connected to said second pivoted lever at said spaced point, and the other end of which is operatively connected to said supporting member.