# United States Patent

**Bassist**

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[54] **APPARATUS FOR FEEDING AND TENSIONING FILLING THREADS TO A WARP KNITTING MACHINE**


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[52] **U.S. Cl.** .....**66/84,** 28/1 CL, 66/146, 156/440

[51] **Int. Cl.** .....**D04b 23/12**

[58] **Field of Search**.....28/1 CL; 66/84 A, 146; 156/439, 440



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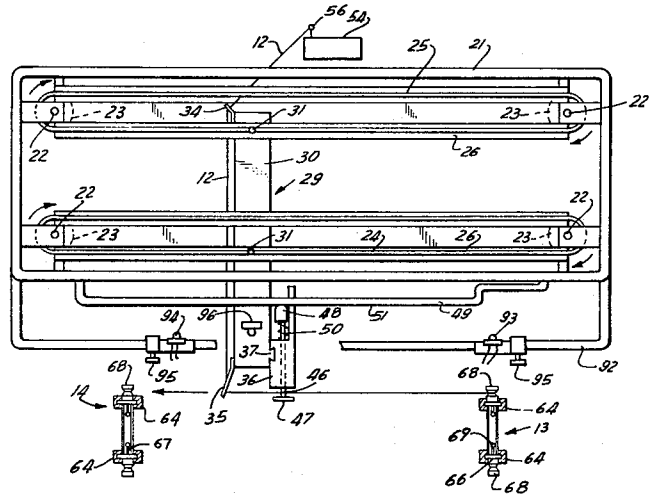
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[57] **ABSTRACT**

First and second spaced apart conveyors, extending toward the knitting instrumentalities of a knitting machine, each carry a plurality of thread clamping means. Guide means bring filling threads from filling thread supplies to the first conveyor where they are clamped. The guide means then moves to the second conveyor to pull filling threads from the supplies and draw them between the conveyors, the filling threads being clamped in the second conveyor. At some point during movement of the guide means, locking means lock the filling threads against further removal from the supplies so as to provide a predetermined tension to the filling threads which become clamped between the conveyors. Means may be provided for tensioning the filling threads as they are withdrawn from their supplies.


**13 Claims, 4 Drawing Figures**



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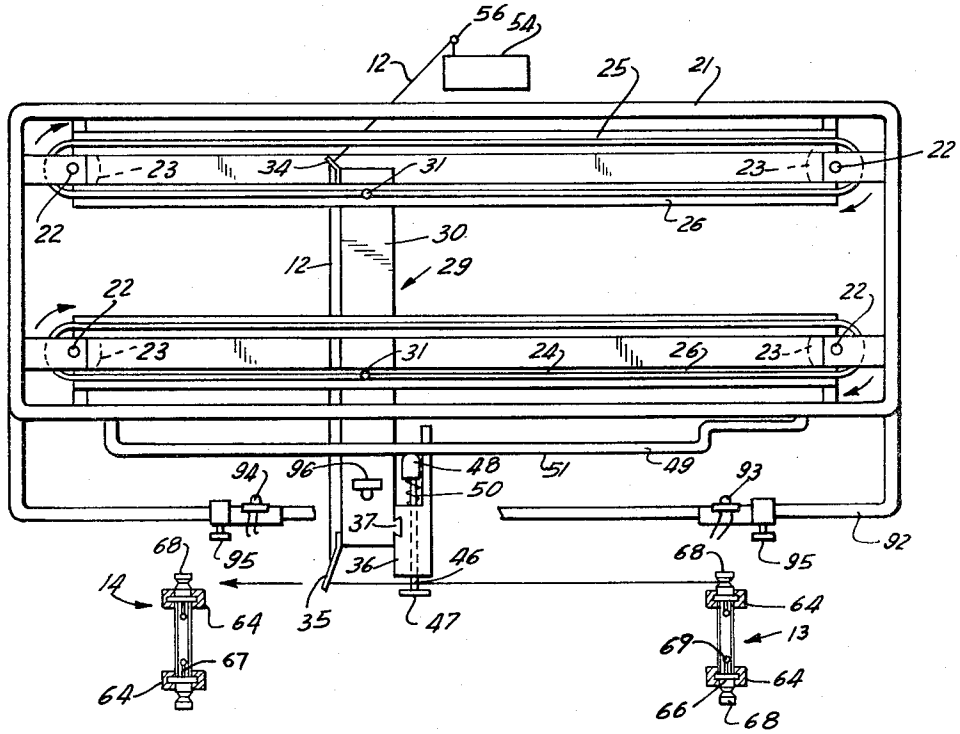
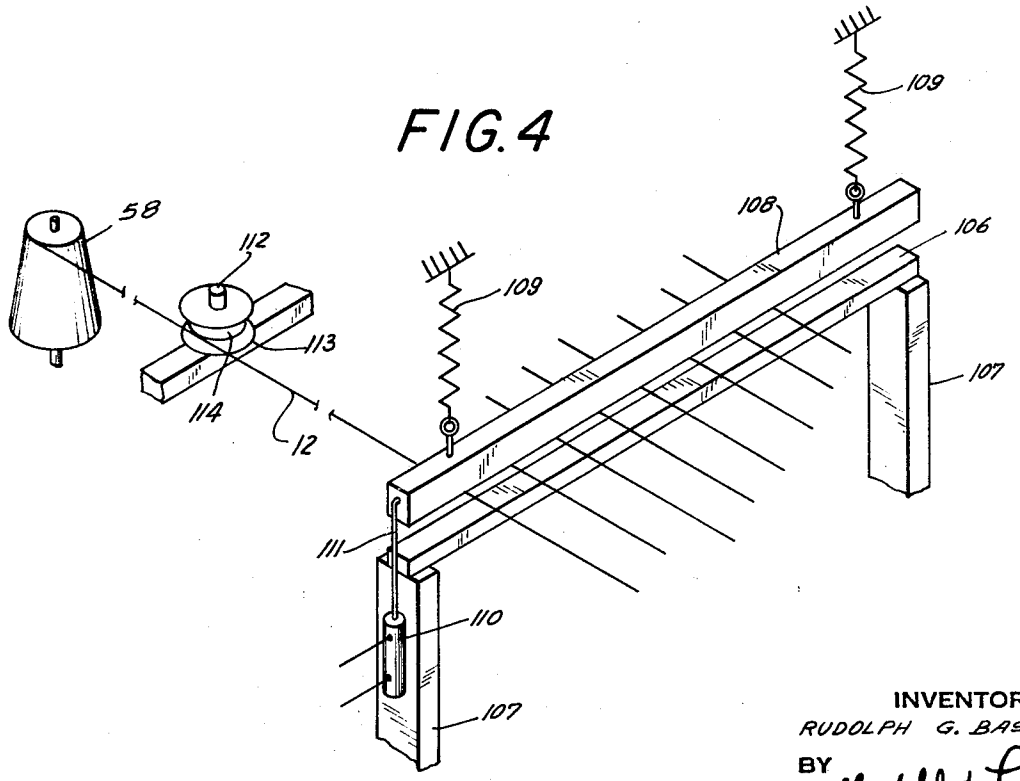



FIG. 1

FIG. 4




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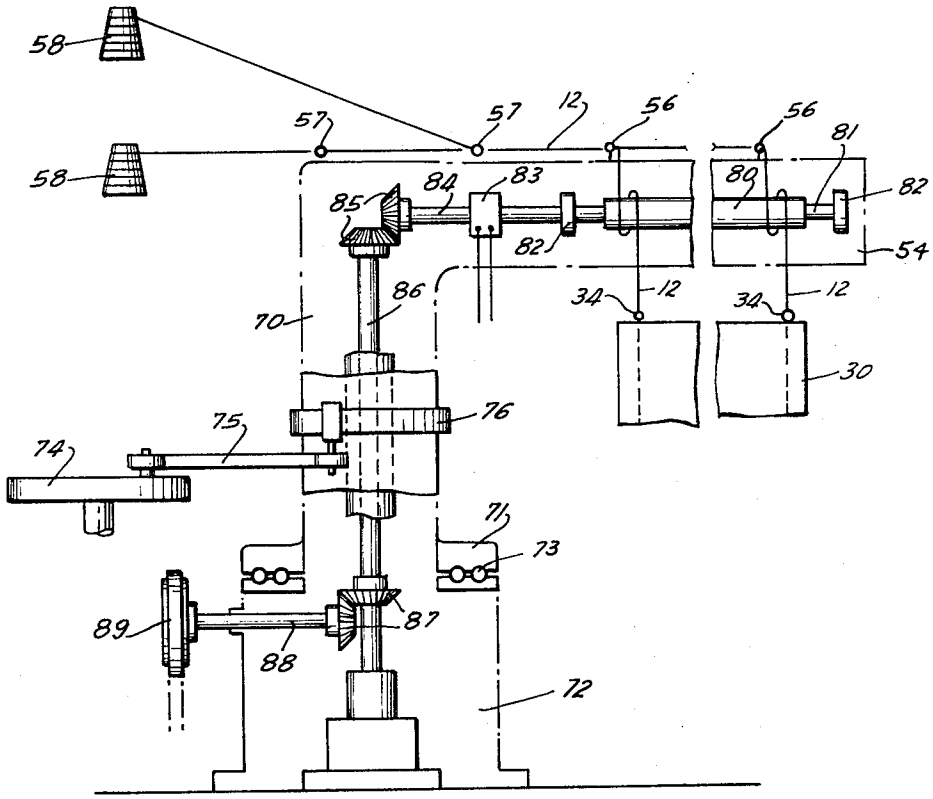



FIG. 2

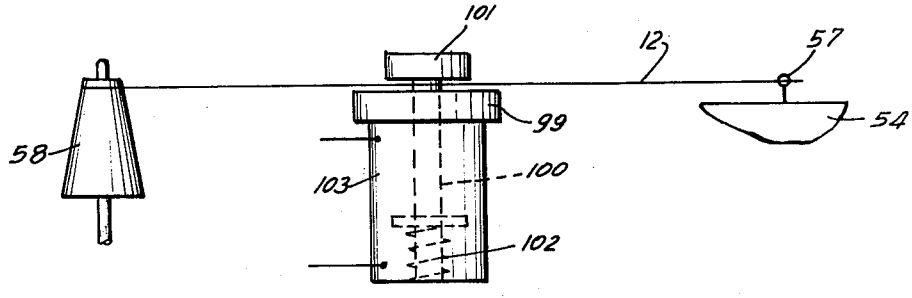



FIG. 3

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# APPARATUS FOR FEEDING AND TENSIONING FILLING THREADS TO A WARP KNITTING MACHINE

This invention relates to warp knitting machines, and more particularly to such machines capable of knitting fabric incorporating filling threads extending across the width of the fabric.

Copending application Ser. No. 57,235, filed July 22, 1970, discloses an apparatus for feeding filling threads to a knitting machine, from relatively stationary supplies, so that the filling threads become a permanent part of the knit fabric. In that apparatus, first and second spaced apart conveyors, each of which may be an endless chain, carry a plurality of thread clamping means. A guide means moves between the two conveyors, and pulls filling threads from the relatively stationary supplies. A plurality of first conveyor clamping means are operated simultaneously, as the guide means crosses them, to clamp the filling thread ends. Filling threads are drawn from the first conveyor to the second as the guide means moves, and a plurality of second conveyor clamping means are operated simultaneously as the guide means crosses them, to clamp the filling threads. Thereafter, the filling threads are cut between the second conveyor and the guide means. The conveyors then move the filling threads to the knitting instrumentalities of the knitting machine.

It is an object of the present invention to furnish apparatus for providing any desired amount of tension in the filling threads applied to the conveyors, this tension of course remaining with the filling threads when they are introduced into, and become part of, the knitted fabric.

The manner in which this and other objectives are achieved, as well as additional features and advantages of the invention, will be apparent from the following description in which reference is made to the accompanying drawings.

In the drawings:

FIG. 1 is a vertical cross sectional view through the first and second conveyors, looking in the direction of the knitting machine, and showing the filling thread guide means;

FIG. 2 is a schematic representation of one embodiment of a thread tensioning means according to the invention;

FIG. 3 is a schematic representation of another embodiment of a thread tensioning means according to the invention; and

FIG. 4 is a schematic representation of still another embodiment of a thread tensioning means according to the invention.

FIG. 1 illustrates a first conveyor **13** and a second conveyor **14**, each of which may be an endless chain having a top run and a bottom run. The conveyors are spaced apart a distance slightly exceeding the width of the needle bed of the knitting machine (not shown), i.e., the width of the knitted fabric produced by the machine. The conveyors move continuously when the knitting machine is in operation. As viewed in Fig. 1, the top run of each conveyor moves away from the viewer (and toward the knitting machine), and the bottom run of each conveyor moves toward the viewer.

Each link of the chain comprising each conveyor **13** and **14** has lateral flanges slidably arranged in support channels **64** mounted on a stationary framework (not shown). A thread clamp carried by each link comprises a cylindrical anvil **66** fixed to the link, a stem **67** extending slidably through an aperture in the anvil and link, and a clamping head **68** fixed to the upper end of stem **67**. A follower **69** is fixed to the lower end of stem **67**, and a compression spring (not shown) surrounds stem **67** to normally hold clamping head **68** against anvil **66** Actuator means are provided beneath the upper run of each conveyor for engaging a number of followers **69** simultaneously and opening the clamps to permit a filling thread **12** to be introduced into each clamp. Thereafter the actuator permits the clamps to close, and they remain closed until they reach the knitting instrumentalities of the machine where one clamp of each conveyor are operated in pairs to release a filling thread and deposit it behind the knitting needles for incorporation in the fabric being produced.

The filling threads are introduced into the conveyor clamps by a thread guide means **29** (Fig. **1**). Arranged above and generally crosswise with respect to conveyors **13** and **14** are a pair of rectangular stationary frames **21** (only one being visible in Fig. **1**). Each frame carries four stub shafts **22**, each of which rotatably supports a sprocket wheel **23**. An endless conveyor chain **24** is trained about the lower pair of sprocket wheels **23** of each frame **21**, and another endless conveyor chain **25** is trained about the upper pair of sprocket wheels **23**. Thus, four conveyor chains **24** and **25** are carried by frames **21**. A fixed channel-shaped support **26** may be provided to support the top and bottom runs of each chain. One stub shaft **22** of each conveyor chain is connected by a suitable transmission (not shown) to the main drive shaft of the machine so as to move all the chains **24** and **25** in such a way that the lower run of each chain moves from the right toward the left in Fig. **1**, i.e., from filling thread conveyor **13** toward filling thread conveyor **14**. The purpose of the chains **24** and **25** is to move the thread guide means **29** between conveyors **13** and **14**.

The thread guide means is illustrated as a rectangular-block-shaped carriage **30** arranged between frames **21**, and having two pins **31** projecting from each side. Each pin **31** is pivotally connected at its end to one of the chains **24** and **25**. Thus, at a time when the portion of the chain to which each pin **31** is connected is in the lower run of the chain, as shown in the drawings, carriage **30** is moving from conveyor **13** toward conveyor **14**. After passing over the latter, carriage **30** moves upwardly around the sprocket wheels **23** and back toward conveyor **13**. After passing over the latter conveyor, carriage **30** moves downwardly around the opposite sprocket wheels **23** and its direction of movement is again reversed.

Along its front upper edge, i.e., its upper edge facing conveyor **14**, carriage **30** is furnished with a plurality of thread guide members or eyelets **34**, and the same number of eyelets **35** is provided along its front lower edge. The number of eyelets **34** or **35** is equal to the number of individual filling threads **12** which are to be applied simultaneously to the conveyors **13** and **14** during each pass of carriage **30** from conveyor **13** to conveyor **14**. Theoretically, any number of filling threads can be applied; for example, **72** filling threads may be simultaneously applied to the conveyors.

Adjacent to its rear lower edge, carriage 30 carries a horizontal bracket 36 slidable laterally with respect to carriage 30, i.e., slidable in a direction parallel to the length of conveyors 13 and 14. A horizontal projection 37 on carriage 30, having a dovetail cross-sectional shape, is slidably accommodated within a dovetail recess in bracket 36, to effect the sliding.

Bracket 36 carries 72 thread holding means or clamps, the number 72 being illustrative as explained above. Each thread clamp includes a stem 46 extending slidably through a vertical aperture in bracket 36, and carrying a clamping head 47 at its lower end. A single elongated cam follower 48 is located behind the rear face of carriage 30 and is secured to the upper ends of all the stems 46. The extremities of follower 48, which extend beyond the sides of carriage 30, engage the under surfaces of cam bars 49 (only one being visible), these two cam bars being identical except that they are secured to opposite frames 21. A compression spring 50 surrounds each stem 46 between the upper face of bracket 36 and the lower face of follower 48 and urges clamping head 47 against the bottom face of bracket 36, i.e., thread clamping condition. The thread clamps are in this condition except when the ends of follower 48 are beneath the lowest portion 51 of cam bars 49. In this latter case, follower 48 pushes stems 46 downwardly against the force of springs 50 and moves clamping heads 47 away from the bottom face of bracket 36, so that threads 12 can move with respect to the clamps.

Arranged above carriage 30 is a long arm 54 swingable about a verticle pivot, as will be described in more detail below with respect to Fig. 2. The portion of arm 54 above carriage 30 is furnished with, in this example, 72 eyelets 56, and near its pivot, arm 54 is furnished with another set of 72 eyelets 57 (Fig. 2). Each eyelet 56 and 57 guides a thread 12 from one of 72 thread supplies 58, which may be in the form of the usual wound cones, to one of the eyelets 34 on carriage 30. From eyelet 34, each thread is guided through an eyelet 35, and then to one of the clamps including head 47. Through a suitable transmission described below, arm 54 is swung back and forth through an arc having a long enough radius so that its free end carrying eyelets 56 remains close, and substantially parallel, to carriage 30. Arm 54 thereby serves to prevent any slack in threads 12 from becoming entangled in the mechanism which moves carriage 30. If desired, arm 54 may carry conventional type finger tension means to maintain tension in threads 12.

At the beginning of each cycle, carriage 30 is to the right of conveyor 13 in Fig. 1, and the ends of the filling threads are clamped by heads 47. As carriage 30 moves to the left it inserts the ends of filling threads 12 into clamps 66, 68 of conveyor 13, and the clamps grip these threads. Heads 47 then release the threads. Carriage 30 then moves toward conveyor 14, and during this movement filling threads are pulled from supplies 58 and drawn between conveyors 13 and 14. When carriage 30 reaches conveyor 14, it inserts the threads into clamps 66, 68 of that conveyor, which grip the threads. The threads are then cut to the left of conveyor 14, and heads 47 clamp the newly cut ends. Carriage 30 returns to the right of conveyor 13, to begin a new cycle, and conveyors 13 and 14 bring the filling threads to the knitting machine.

Fig. 2 illustrates one approach, according to this invention, for applying any selected tension to the filling threads 12 extending between the conveyors 13 and 14. The arrangement of Fig. 2 is capable of controlling the tension in the filling threads as they are drawn between conveyors 13 and 14 by movement of carriage 30, and is also capable of determining the tension in the filling threads clamped in both conveyors 13 and 14.

Arm 54 is hollow, and extends horizontally from the upper end of a hollow vertical post 70. A flange 71 extends outwardly from the lower end of post 70 and serves as the upper race of a large ball bearing. The upper surface of a hollow stationary pillar 72 serves as the lower race of the bearing, which also includes balls 73. It will be appreciated, therefore, that post 70 and arm 54 are permitted to pivot, with respect to pillar 72, about the vertical axis of the post. Arm 54 and post 70 are oscillated by means of a wheel 74 rotated continuously by the main drive shaft of the knitting machine. A link 75 is pivoted at one end to wheel 74 at an eccentric location thereon, and at its other end to a band 76 fixed to and surrounding post 70. As wheel 74 rotates, arm 54 swings back and forth, and since both the arm and conveyors 24 and 25 supporting carriage 30 are driven from the main drive shaft of the machine, it is a simple matter to cause arm 54 to remain above carriage 30 as they both move.

Each filling thread 12 is wrapped, at least once, around a roller 80 within arm 54, the roller being fixed to a shaft 81 rotatably mounted in bearings 82 carried by arm 54. One end of shaft 81 terminates at an electric clutch and brake device 83 of conventional design. The clutch and brake device 83 is also connected to a shaft 84 which is rotated continuously, via bevel gears 85, by a vertical shaft 86, itself rotated continuously, via bevel gears 87, by a shaft 88. Shaft 88 is rotated by the knitting machine by means of a belt and pulley 89 mounted on the end of the shaft. When the clutch portion of device 83 is engaged, the brake portion is disengaged, and roller 80 rotates, thereby feeding filling threads 12 to carriage 30. When the brake portion of device 83 is engaged, the clutch portion is disengaged, and roller 80 stops, locking filling threads 12 against further withdrawal from their supplies 58.

Operation of clutch and brake device 83 is controlled by the movement of carriage 30. Fixed to one of the frames 21 (Fig. 1) is a switch support bar 92 carrying two electrical switches 93 and 94. Each switch 93 and 94 may be adjustably positioned along the length of bar 92, and fixed in any position of adjustment by means of a set screw 95. Both switches 93 and 94 are arranged in electric circuit with device 83, the arrangement being such that when switch 93 is actuated, the clutch is engaged and brake disengaged, and when switch 94 is actuated, the clutch is disengaged and the brake engaged. A switch actuator 96 is carried by carriage 30, and switches 93 and 94 are always in the path of movement of actuator 96 regardless of their positions of adjustment along bar 92.

Thus, as carriage 30 moves over conveyor 13 at the beginning of each cycle, actuator 96 operates switch 93 and engages the clutch portion of device 83. As a result, roller 80 is rotated to feed filling threads 12 from supplies 58 to carriage 30. By altering the gear ratios at 85 and 87, the relationship between the speed of rotation of roller 80 and the speed of movement of carriage

30 can be adjusted as desired, and hence the tension in the filling threads 12 as carriage 30 moves can be adjusted as desired.

When actuator 96 reaches switch 94, which need not necessarily be located over conveyor 14, the brake portion of device 83 is engaged and roller 80 is prevented from rotating further. Since threads 12 are wrapped around roller 80, when the latter is braked no further thread can be withdrawn from supplies 58. However, since carriage 30 continues moving toward conveyor 14, the portion of each thread 12 extending between roller 80 and conveyor 13 must stretch, thereby increasing its tension. It will be appreciated, therefore, that by selecting the location of switch 94 along bar 92, the tension in the filling threads which become clamped between the conveyors is determined.

Obviously variations in the embodiment just described can be made. For example, photoelectric cells or magnetically responsive switches may be used in place of switches 93 and 94, and appropriate actuators for such devices will be mounted on carriage 30. Also, a two position switch may be carried by carriage 30, and adjustable actuators may replace switches 93 and 94.

Fig. 2 illustrates an embodiment in which the filling threads are positively fed to carriage 30, by roller 80, to control tension in the threads while they are fed. This feature, however, is not essential. The fact that the filling threads can be locked against further withdrawal from their supplies is essential, since with such an arrangement simple change in placement of switch 94 determines the ultimate tension in the filling threads conveyed to the knitting machine. However, in certain circumstances, the combination of these two features may prove desirable.

Fig. 3 illustrates an embodiment in which only the locking feature is present. Each filling thread 12 withdrawn from its supply 58 extends to arm 54 and from there to carriage 30 without passing around any roller, such as roller 80. Thus, the threads 12 are not positively fed to carriage 30, but instead are pulled from supplies 58 by the movement of carriage 30 after one end of each thread is clamped in conveyor 13. Located between each supply 58 and arm 54 is a thread-locking device comprising a fixed cylindrical anvil 99, a stem 100 extending slidably through an aperture in the anvil, and a clamping head 101 fixed to the upper end of stem 100. Thread 12 passes between anvil 99 and head 101. A spring 102 urges stem 100 and head 101 upwardly, and a solenoid 103 surrounds stem 100. When the solenoid is energized, it moves stem 100 downwardly, against the force of spring 102, to clamp thread 12 between head 101 and anvil 99 thereby locking the thread against further withdrawal from supply 58. Solenoid 103 is in electric circuit with switches 93 and 94 (Fig. 1), so that when switch 94 is operated by actuator 96, solenoid 103 is energized and thread 12 is clamped. The solenoid remains energized until switch 93 is actuated, at which time it is deenergized. A separate thread-locking device 99, 101 may be furnished for each filling thread.

In Fig. 4, a single locking device is furnished for all the filling threads. The locking device includes an elongated anvil 106 mounted on a fixed support 107. Above anvil 106 is an elongated clamping head 108 movable toward and away from anvil 106 in suitable guides (not shown). Threads 12 pass between anvil 106 and head 108. Springs 109 normally hold clamping head 108 away from anvil 106, as shown in the drawing. A solenoid 110 is fixed to support 107, and the solenoid armature 111 is fixed to clamping head 108. When solenoid 110 is energized, its armature 111, and hence clamping head 108, will move downwardly, against the force of springs 109, to clamp threads 12 between anvil 106 and clamping head 108. As a result, threads 12 are locked against further withdrawal from supplies 58. Solenoid 110 is in electric circuit with switches 93 and 94 in the same way as described above with respect to solenoid 103.

Each thread 12 extends around a stationary vertical pin 112 projecting from a stationary plate 113. An annular weight 114 fits loosely around pin 112. The pressure of weight 114 on thread 12 provides tension in the thread as it is withdrawn from supply 58 by movement of carriage 30. The amount of this tension can be varied by replacing weight 114 with a lighter or heavier weight.

The invention has been shown and described in preferred form only, and by way of example, and many variations may be made in the invention which will still be comprised within its spirit. It is understood, therefore, that the invention is not limited to any specific form or embodiment except insofar as such limitations are included in the appended claims.

What is claimed is:

1. Apparatus for feeding filling threads to a warp knitting machine comprising

first and second spaced apart conveyor means extending toward the knitting instrumentalities of the machine,

a plurality of thread clamping means carried by and movable with each of said conveyor means,

a plurality of filling thread supplies,

guide means movable independently of said thread supplies for bringing a plurality of filling threads from said supplies to said first conveyor means where they are simultaneously clamped by said clamping means of said first conveyor means, said guide means moving from said first conveyor means to said second conveyor means to draw filling threads, pulled from said supplies, between said conveyors, and said guide means bringing the filling threads to said second conveyor means where they are simultaneously clamped by said clamping means of said second conveyor means, and

means for locking the filling threads against further withdrawal from said supplies at selected positions of said guide means during movement of the latter from the first to the second conveyor means, so as to selectively adjust the tension in the filling threads which becomes clamped between said conveyors, said locking means being outside the path of movement of said guide means as the latter moves from said first to said second conveyor means.

2. Apparatus as defined in claim 1 including means for applying a predetermined tension to the filling threads as they are withdrawn from said supplies during movement of said guide means between said conveyors.

3. Apparatus as defined in claim 1 including means responsive to movement of said guide means for controlling the operation of said locking means.

4. Apparatus as defined in claim 1 including electrical means for operating said locking means, and means in electrical circuit with said electrical means and responsive to movement of said guide means for controlling the operation of said electrical means.

5. Apparatus as defined in claim 4 wherein said means in electrical circuit with said electrical means is a switch arranged along the path of movement of said guide means.

6. Apparatus as defined in claim 5 including an actuator carried by said guide means for operating said switch.

7. Apparatus as defined in claim 4 wherein said means in electrical circuit with said electrical means is adjustable along the path of movement of said guide means, and means for maintaining said adjustable means in any desired position of adjustment.

8. Apparatus as defined in claim 1 including rotatable means about which the filling threads are wrapped between said supplies and said guide means, and wherein said locking means includes means for locking said rotatable means against further rotation.

9. Apparatus as defined in claim 8 including means for adjusting the speed relationship between said rotatable means and said guide means for applying a selected predetermined tension to the filling threads as said guide means moves between said conveyors.

10. Apparatus as defined in claim 8 wherein said locking means includes an electric clutch and brake arrangement for controlling rotation of said rotatable means, and including means in electrical circuit with said clutch and brake arrangement and responsive to movement of said guide means for controlling the operation of said clutch and brake arrangement.

11. Apparatus as defined in claim 1 wherein said locking means includes an anvil and clamping member between which a filling thread passes, and means for moving said anvil and clamping member into engagement to lock the thread between them.

12. Apparatus as defined in claim 11 including means spaced from said anvil and clamping member for applying a predetermined tension to a filling thread moving between said anvil and clamping head to said guide means.

13. Apparatus as defined in claim 11 wherein said means for moving said anvil and clamping member into engagement includes a solenoid, and including means in electrical circuit with said solenoid and responsive to movement of said guide means for controlling the operation of said solenoid.

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