

Oct. 21, 1958

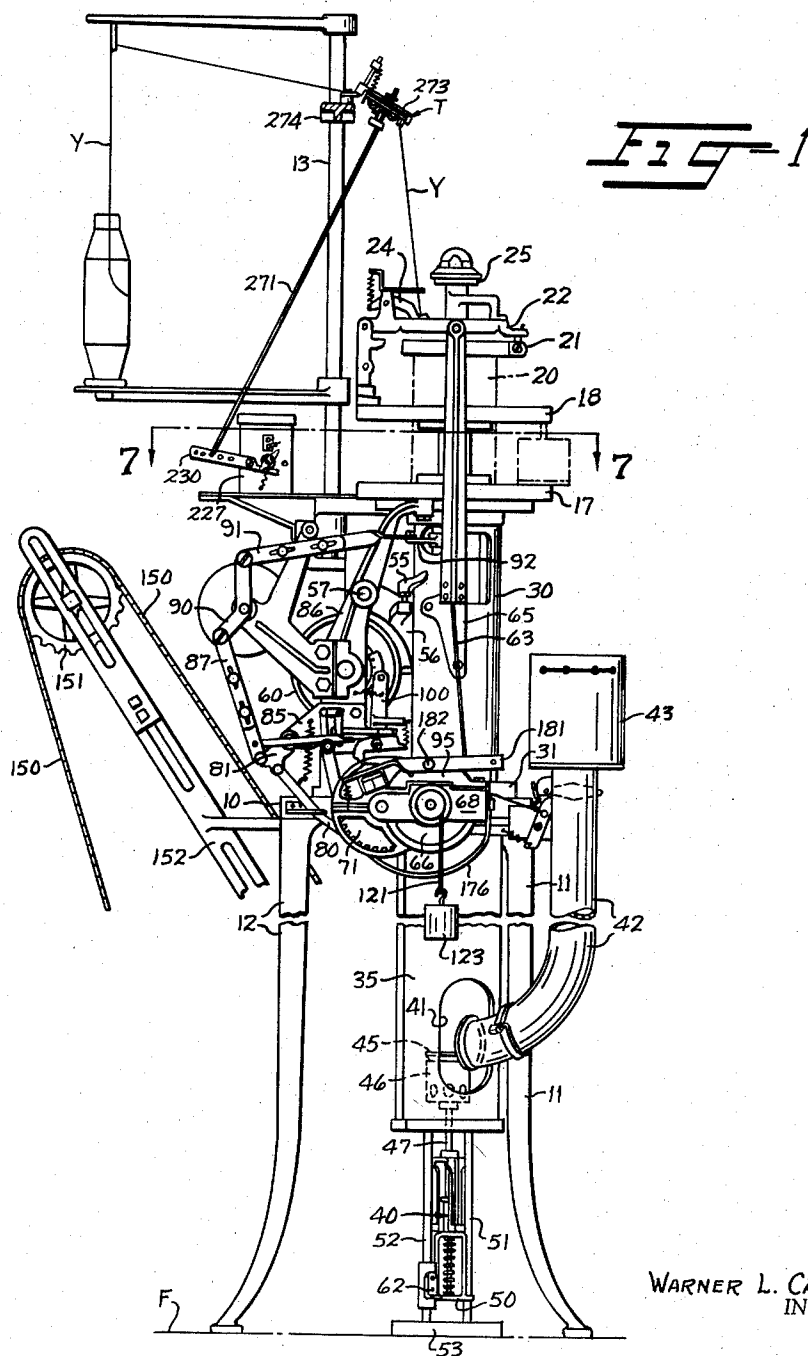
W. L. CARDEN

2,856,764

ARTICLE LENGTH CONTROLLED TENSION APPARATUS
FOR KNITTING MACHINES AND METHOD

Filed Feb. 21, 1955

7 Sheets-Sheet 1



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FIG-2

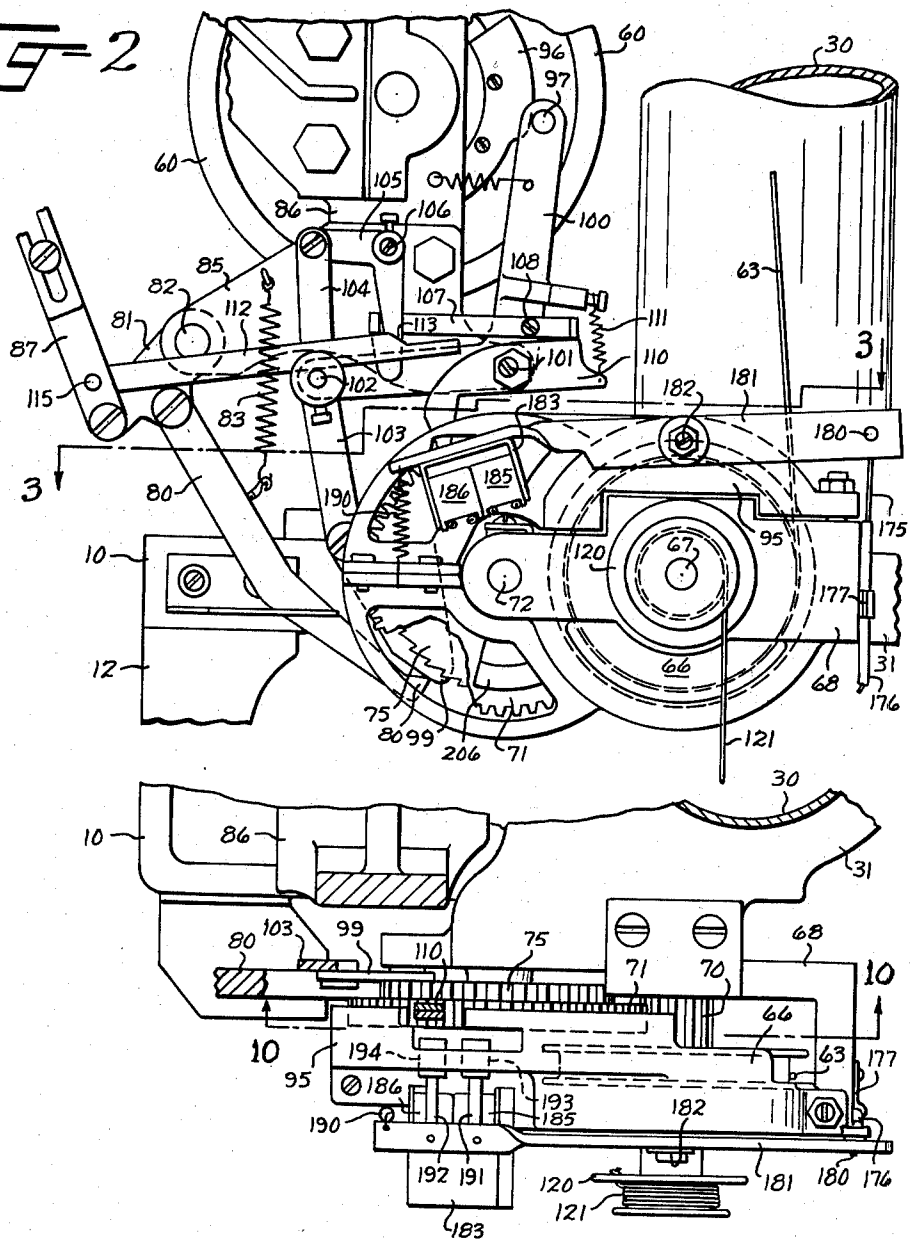


FIG-3

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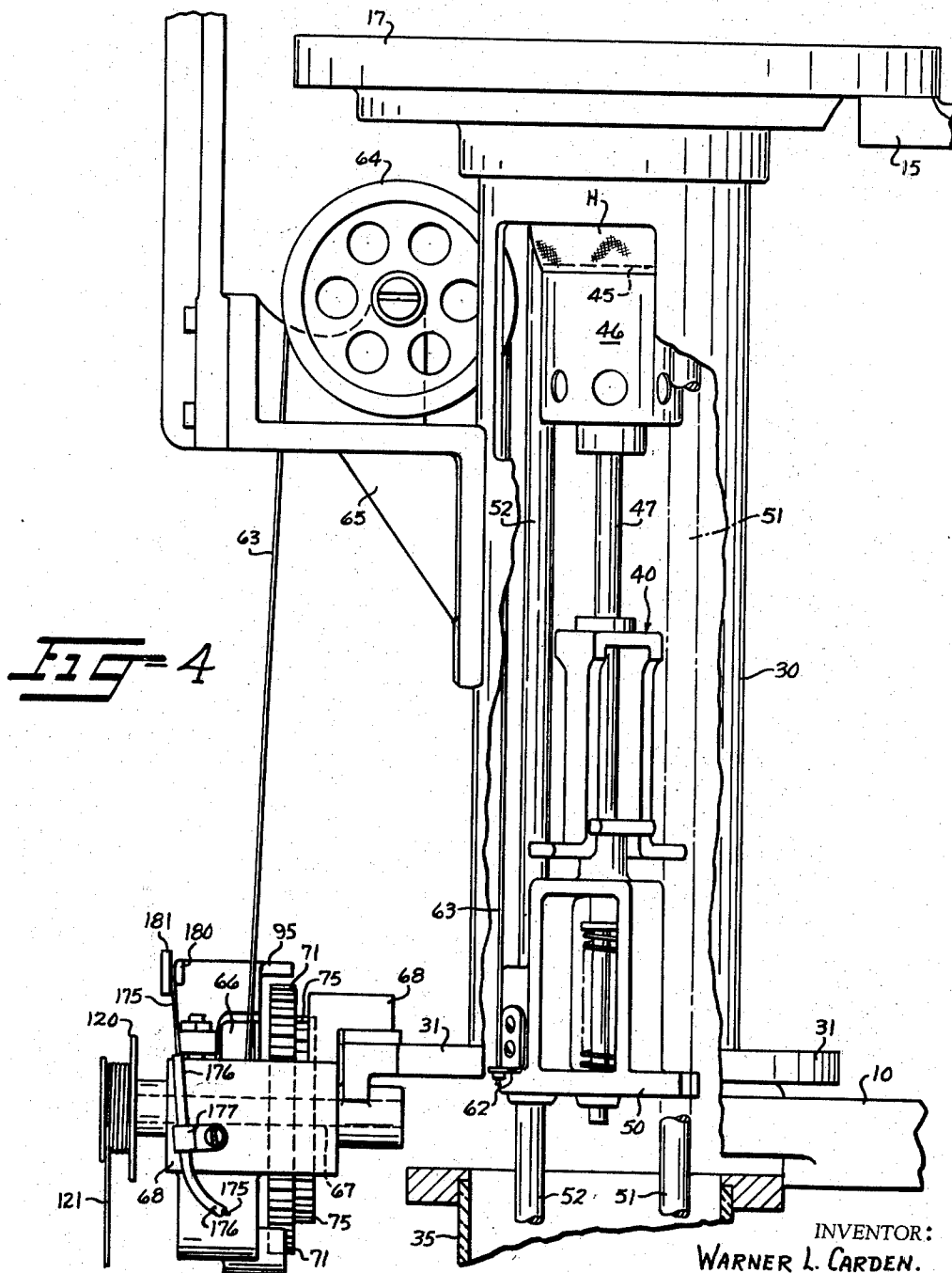
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FIG-5

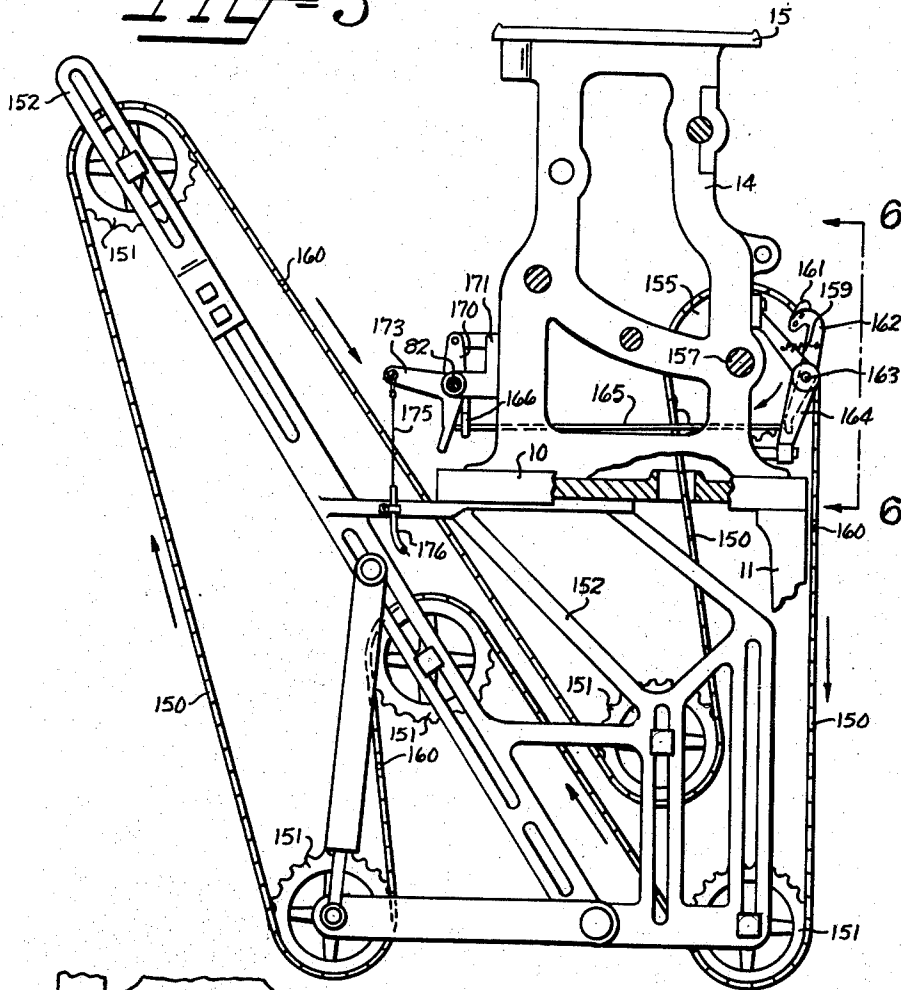
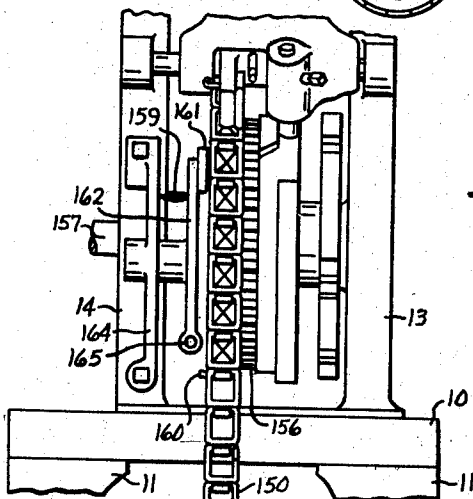


FIG-6



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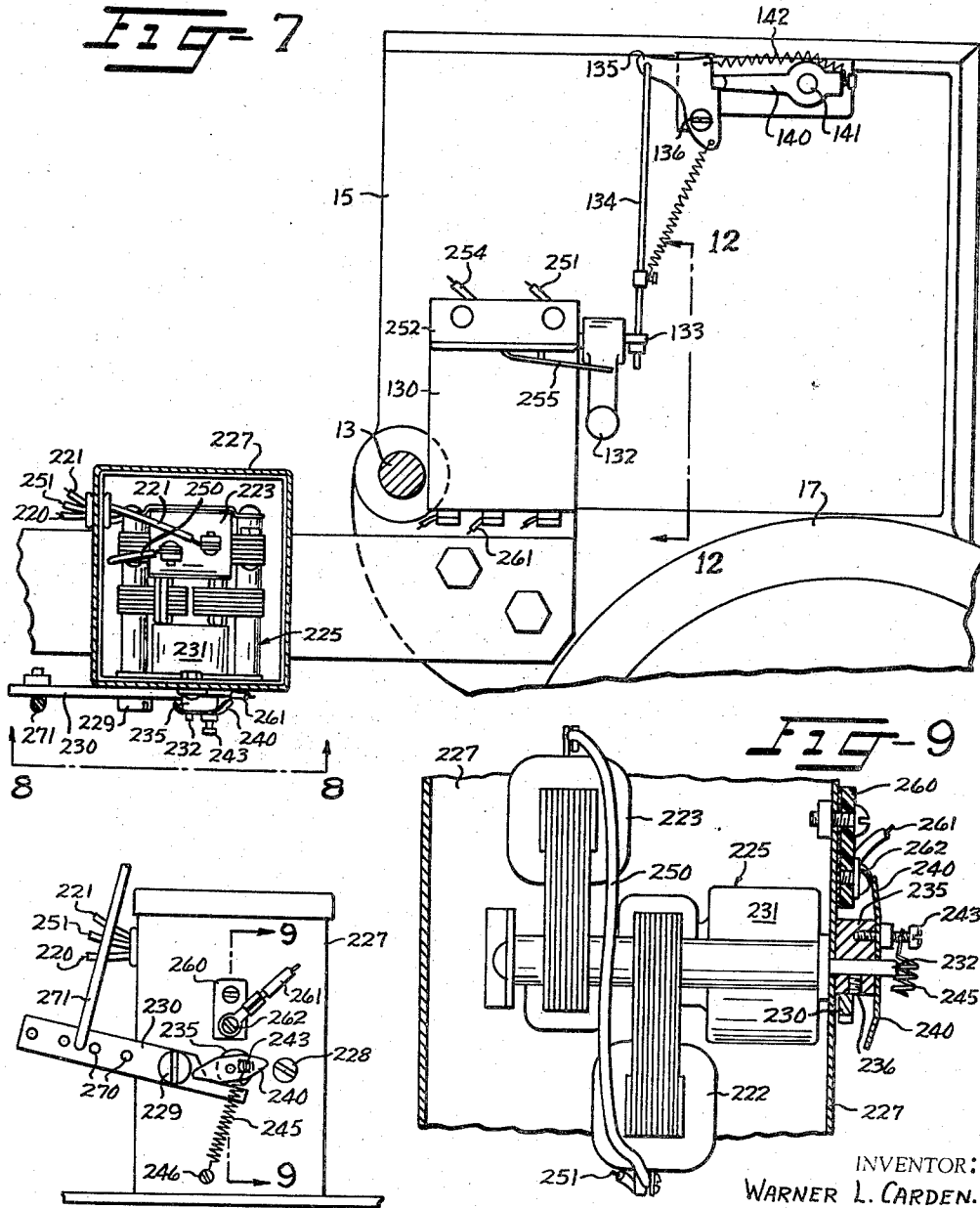
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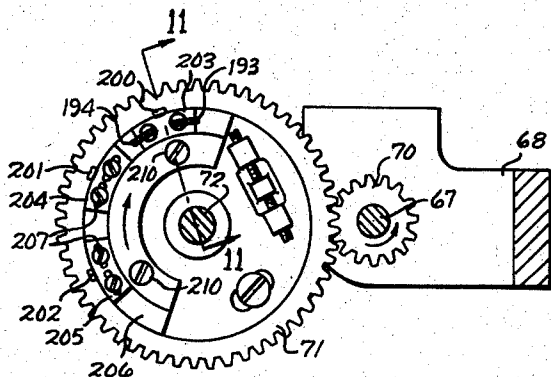


FIG-10

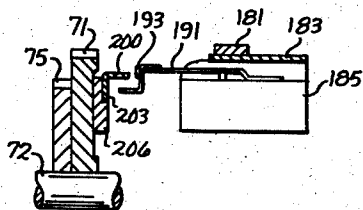


FIG-11

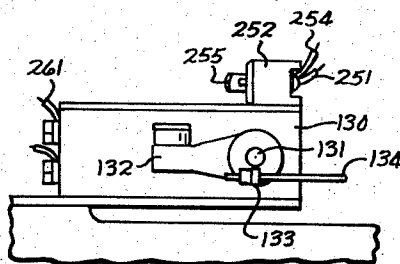


FIG-12

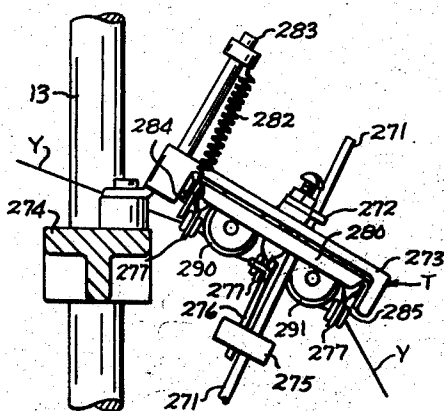


FIG-13

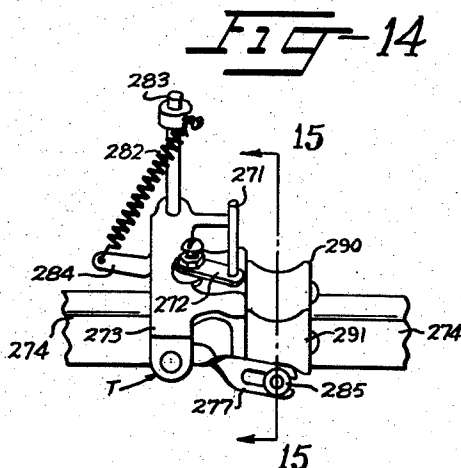


FIG-14

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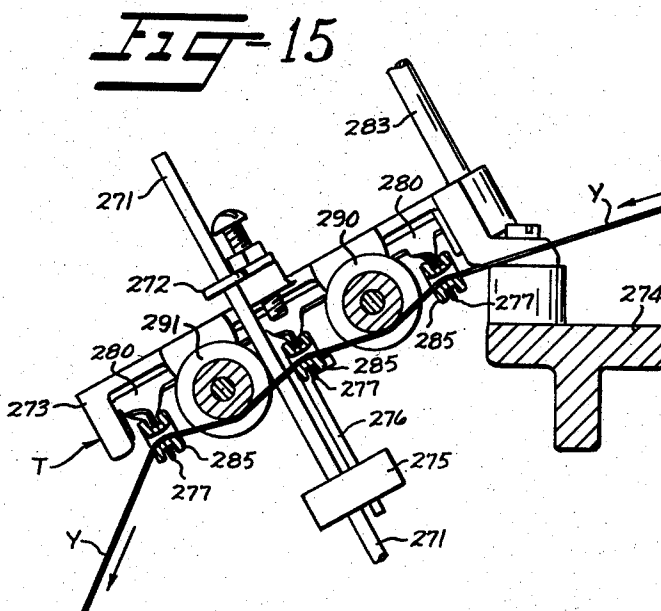
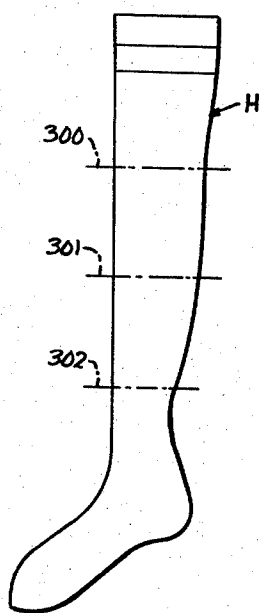
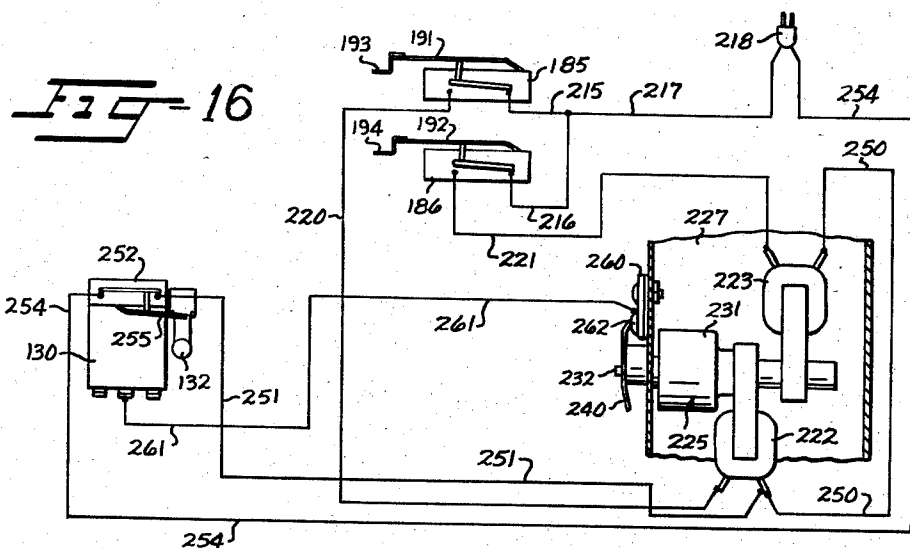
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7 Sheets-Sheet 7



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2,856,764

ARTICLE LENGTH CONTROLLED TENSION APPARATUS FOR KNITTING MACHINES AND METHOD

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Application February 21, 1955, Serial No. 489,348

25 Claims. (Cl. 66—146)

This invention relates to circular knitting machines and, more especially, to an improved apparatus for controlling the yarn as it is fed to the needles wherein the length of the article being knit is instrumental in controlling the amount of tension in the yarn in order to insure that a plurality of successively knit articles, such as ladies' seamless hose, are of uniform length and which will not be marred by shadow lines, streaks or other blemishes and which thereby obviates the necessity of subsequent mating or pairing of hose as has heretofore been required.

Various attempts have been made to control the length of successive hose such as by providing complicated tension devices between the yarn source and the knitting wave, which tension devices operated independently of the accumulated length of predetermined portions of the article being knit and others of which have been controlled by the amount of tension in the portions of the yarn engaging the sinkers or web holders. However, such prior devices have been unsatisfactory, since it is not necessarily the tension in individual loops which determines uniform length of successive articles, but instead, it is the actual overall length of given portions of the fabric in proportion to a given number of knitted courses as effected by the tension in the yarn being fed to the needles which should determine the final length of each successively knit article.

It is therefore an object of this invention to provide an improved yarn tension apparatus in combination with a fabric or hose take-up means wherein the position of the hose or fabric take-up means relative to the knitting wave, and, consequently, the length of the article being knit, determines the amount of tension effected in the yarn at frequent intervals. In other words, the amount of tension effected in the yarn by the improved yarn tension apparatus is determined by the length of the article being knit in proportion to a predetermined number of revolutions of the needle cylinder or in proportion to a predetermined number of knitted courses.

Generally, the invention comprises a reversible electric motor, connected by suitable linkage to a yarn tensioning means and the flow of electric current to the motor is determined by the position of a plurality of circularly spaced projections or switch closing elements mounted on a wheel or gear, relative to a pair of detector switches. The detector switches are mounted on a movable pattern controlled element and the switch actuating arms are normally spaced from the circular path of travel of the series of projections on the gear. The gear is driven through suitable connections with a take-up means clamped or otherwise secured to the lower end of each successive article or hose and which take-up means, during the course of downward movement thereof, imparts rotation to the gear.

At predetermined intervals, say, each time approximately one hundred eighty courses are knit, with a corresponding one hundred eighty revolutions of the needle cylinder, a pattern means imparts movement to the element having the switches thereon and, if the take-up means

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has taken up the fabric an excessive amount relative to the length desired at this time, the actuating arm of one of the switches will engage a corresponding projection on the gear to impart rotation to the motor in one direction.

Conversely, if the take-up means has not taken up the fabric the desired amount, the arm of the other of the switches will engage the corresponding projection on the gear to impart rotation to the motor in the opposite direction. Of course, if the fabric has been taken up the proper amount in proportion to the number of courses knitted, then the two arms of the switches will merely move astride the corresponding projection on the gear, and the motor will not rotate in either direction and the tension in the yarn will not change.

This invention is particularly adapted for use with a grab take-up attachment such as is used on a Model "KN" knitting machine of the type manufactured by Scott and Williams, Inc. and such as is disclosed in a patent to R. H. Lawson, No. 2,625,026 dated January 13, 1953, and also disclosed in an application, Serial Number 207,075, filed January 22, 1951, and now Patent No. 2,709,352.

It is another object of this invention to provide a yarn tension apparatus of the character described with means to break the circuit to the reversible motor, if energized by either detector switch, upon actuation of the usual stop motion of the machine for any reason.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings in which—

Figure 1 is a side elevation of a knitting machine provided with a grab take-up with parts broken away and showing the improved length control yarn tension device associated therewith;

Figure 2 is an enlarged elevation of the central portion of Figure 1;

Figure 3 is a fragmentary sectional plan view taken substantially along the line 3—3 in Figure 2;

Figure 4 is a fragmentary front elevation of the knitting machine, looking at the right-hand side of the central portion of Figure 1, with parts broken away for purposes of clarity;

Figure 5 is a somewhat schematic vertical sectional view through the main frame of the knitting machine, showing the pattern chain therefor and parts of the means for controlling the detector switches;

Figure 6 is an enlarged fragmentary front elevation taken substantially along the line 6—6 in Figure 5;

Figure 7 is an enlarged fragmentary plan view with parts in section and being taken substantially along the line 7—7 in Figure 1;

Figure 8 is a side elevation of the tension actuator taken substantially along the line 8—8 in Figure 7;

Figure 9 is an enlarged longitudinal vertical sectional view taken substantially along line 9—9 in Figure 8, but showing the cam on the motor shaft in a different position;

Figure 10 is a fragmentary elevation taken substantially along the line 10—10 in Figure 3 with the housing for the gear being omitted;

Figure 11 is a fragmentary vertical sectional view taken substantially along the line 11—11 in Figure 10 and showing one of the detector switches adjacent the take-up driven gear;

Figure 12 is a side elevation of a stop-motion switch interposed in the circuit to the detector switches taken substantially along the line 12—12 in Figure 7;

Figure 13 is an enlarged elevation of the yarn tension device shown in the upper central portion of Figure 1;

Figure 14 is an end elevation of the yarn tension device looking at the right-hand side of Figure 13;

Figure 15 is an enlarged fragmentary vertical sectional

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view taken substantially along the line 15—15 in Figure 14;

Figure 16 is a schematic wiring diagram showing the electrical connections for controlling the yarn tension device;

Figure 17 is an illustration of a lady's seamless hose such as may be knit on this type knitting machine.

Conventional parts of machine

Referring more specifically to the drawings, the numeral 10 indicates the lower base plate of a knitting machine having front and rear supporting legs 11 and 12 respectively. A pair of vertically spaced upwardly extending frame members 13, 14 are suitably secured at their lower ends to the base 10 and support an upper horizontal frame member 15 at their upper ends (Figures 5, 6 and 7). The upper horizontal frame member 15 supports the usual lower circular bed or cam plate 17 and an upper circular bed or cam plate 18 spaced above and supported by said lower cam plate 17. The lower cam plate 17 also supports a conventional needle cylinder 20 (Figure 1) which extends upwardly through the upper cam plate 18 and has a sinker cap 21 mounted thereon. The sinker cap 21 has the usual sinkers therein, not shown, which cooperate with the usual latch needles, not shown, in the needle cylinder in drawing stitches.

A hinged latch ring 22 is spaced above the sinker cap 21 and is provided with yarn feeding fingers 24 which are adapted to feed the yarn Y to the latch needles, in the needle cylinder 20. The knitting machine is also provided with a conventional dial and dial needles, not shown, driven through suitable gearing 25 in a conventional manner. A needle cylinder raising tube or sock horn 30 is slidably mounted in the cam plate 17 and extends downwardly therefrom and the lower end thereof is slidably mounted in a bracket 31 fixed on the base 10 of the knitting machine (Figures 3 and 4).

A clear plastic sleeve 35 is provided directly beneath and in axial alignment with the cylinder raising tube 30 for reception of the grab take-up broadly designated at 40 (Figures 1 and 4). The sleeve 35 has an opening 41 therein for the reception of the lower end of a clear plastic tube 42 which extends upwardly and has a receptacle 43 at the upper end thereof. The grab take-up mechanism 40 is of the type manufactured by Scott and Williams, Incorporated, Laconia, N. H., and as disclosed in said Patents No. 2,625,036 and No. 2,709,352. Therefore, only a brief description thereof will be given.

The grab take-up mechanism 40, which is also a form of hose tensioning device, includes a clamp member 45 at the upper end thereof which mates with, and at times is clamped against, the upper surface of a cup 46 rotatable on the upper end of a tubular shaft 47 (Figures 1 and 4) and the lower end of which is slidably mounted in a carrier 50. The carrier 50 is mounted for vertical sliding movement on a pair of vertically spaced guide rods 51, 52 whose lower ends are secured in a foot member 53 resting on the floor F on which the knitting machine rests. The upper ends of the guide rods 51 and 52 are supported in a ring, not shown, fixed to the upper end of the cylinder raising tube 30.

The needle cylinder supporting tube 30 has a bracket 55 fixed thereto (Figure 1) which is engaged by an outwardly projecting portion of a lever arm 56 oscillatably mounted on a shaft 57 supported by the side frame 14 of the knitting machine. The lower end of the lever 56 is engaged by conventional cams, not shown, on a main pattern drum 60 of the knitting machine, for raising and lowering the needle cylinder 20. The needle cylinder 20 is thus raised and lowered relative to the needle actuating cams on the upper cam plate 18 to vary the length of stitches drawn by the needles according to a predetermined pattern on the main pattern drum 60. The

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reading or lower end of the lever 56 has conventional cams thereon which are adjustable by screws, not shown which are conventional to this type of knitting machine and which are used to vary the amount the needle cylinder 20 is raised or lowered relative to the upper cam plate 18.

The carrier 50 at the grab take-up 40 (Figures 1 and 4) has an anchor in the form of an angle clip 62 fixed thereto to which the lower end of a flexible cable or cord 63 is connected and which extends upwardly and partially around a pulley 64. A portion of pulley 64 loosely penetrates tube 30. The pulley 64 is journaled on a bracket 65 fixed to the needle cylinder raising tube 30 (Figure 4). The cable 63 then extends downwardly in Figures 1 and 4 and is wound around a pulley or take-up drum 66 (Figure 3) fixed on a shaft 67. One end of the shaft 67 is rotatably mounted in the bracket 31, and its other end is rotatably mounted in a bracket 68 suitably secured to the bracket 31.

The drum 66 has a relatively small pinion 70 fixed thereto or integral therewith which meshes with a relatively large pinion or gear 71 (Figures 3, 4 and 10) journaled on a shaft 72 and having a ratchet wheel 75 suitably secured thereto. Opposite ends of the shaft 72 are fixed in the brackets 31, 68.

The ratchet wheel 75 is adapted to be, at times, engaged by a ratchet pawl 80 (Figures 1, 2 and 3) whose upper end is pivotally mounted on an arm 81 secured on an oscillating shaft 82 which is oscillated during operation of the machine through a link connected to the usual oscillating quadrant of the machine, not shown. The lower end of the pawl 80 is urged into engagement with the ratchet wheel 75 by means of a tension spring 83, one end of which is connected to the ratchet pawl 80 and the other end of which is connected to a bracket 85 extending from the main pattern drum support arm 86. The bracket 85 supports one end of the oscillating shaft 82.

The arm 81 also has a lower end of a link 87 oscillatably mounted thereon which extends upwardly and is suitably secured to one end of a bell crank 90 (Figure 1) oscillatably mounted intermediate its ends on a fixed part of the knitting machine. The other end of the bell crank 90 has one end of a link 91 oscillatably mounted thereon, the opposite end of which is oscillatably mounted on the outer free end of a bracket 92. The inner end of the bracket 92 is fixed on the upper end of the guide rod 52 for continuously imparting oscillation to the guide rod 52, during the knitting operation, to produce a twisting motion to the guide bar 52 to maintain freedom of downward movement of the carriage 50 thereon as disclosed in said Patent No. 2,625,026.

A cover plate or top gear housing 95 (Figures 1, 2, 3 and 4) is fixed to the bracket 68 and covers the winding drum 66 as well as the relatively large pinion 71. The main pattern drum 60 has an end cam or plate 96 (Figure 2) fixed thereto which is adapted to, at times, engage and oscillate a roller 97 fixed in the upper end of a pivoted bell crank or control level 100 pivotally secured as at 101, on the bracket 86. The rear end of the substantially horizontal arm of bell crank 100 has a stub shaft 102 fixed thereon. The upper end of a connecting link 103 is pivotally secured on the stub shaft 102 and the lower end of the link 103 is pivotally secured to a pivoted idler plate or guard 99 (Figures 2 and 3) which is adapted to at times engage and move the ratchet pawl 80 out of engagement with the teeth on the ratchet wheel 75 to prevent racking of the same by the ratchet pawl 80 as disclosed in said patent.

The stub shaft 102 on the bell crank 100 also has the lower end of a connecting link 104 oscillatably mounted thereon which extends upwardly and has one leg of a bell crank 105 pivotally connected thereto. The bell

crank 105 is oscillatably mounted on the frame or standard 86, as at 106, and its vertical leg is hooked to form a notch therein for the reception of the out-turned end of a pivoted lever 107. The lever 107 is pivotally mounted, as at 108, on the bell crank 100 and engages the tail portions of a pair of gear dogs or hold-back pawls, only one of which is shown at 110 in Figure 2. The lower ends of the dogs 110 are adapted to, at times, engage the teeth of the relatively large pinion 71. The gear dogs 110 are normally urged into engagement with the gear 71 and the lever 107 by suitable springs 111 connected between the gear dogs 110 and the bell crank 100.

The stub shaft 102 supports and guides a control rod 112 having a cam surface 113 thereon which at times engages the out-turned rear end of the lever 107. The control rod 112 is pivotally mounted, as at 115, on the connecting link 87. The shaft 67 also has a sheave or drum 120 fixed thereon (Figures 1, 2, 3 and 4) to which one end of a cord 121 is attached. The cord 121 is wound about the sheave 120 and its other end has a weight 123 fixed thereto (Figure 1). The weight 123 partially counterbalances the weight of the grab take-up 40.

In operation, upon the completion of each successive hose, the grab take-up mechanism 40 occupies substantially the position shown in Figure 1 and will release the lower end of the hose so that automatic means, not shown, will direct an air stream into the tube 42 to blow the hose through the opening 41 in sleeve 35, into and through the tube 42 and into the receptacle 43. The grab take-up mechanism 40 is then moved upwardly along guide rods 51, 52 since the pawl 80 racks the ratchet wheel 75 to thus permit the cable 63 to raise the grab take-up mechanism 40. The pin or roller 97 on the bell crank 100, in the upper portion of Figure 2, will have then been engaged by the low portion of cam 96 so the bell crank 100 will have moved in a counterclockwise direction from the position shown in Figure 2 to move the idler plate 99 out of engagement with the pawl 80. This permits the spring 83 to move the pawl 80 into engagement with the ratchet wheel 75.

Oscillation is imparted to the pawl 80 through the oscillatable shaft 82 and the arm 81. As the pawl 80 racks the ratchet wheel 75 one step in a counterclockwise direction in Figure 2 the gear dogs 110 are moved downwardly by the springs 111 into engagement with gear 71 to prevent the gear 71 from turning in a clockwise direction as the ratchet pawl 80 moves rearwardly to engage another tooth on the ratchet wheel 75.

It is thus seen that the cable 63 is wound onto the winding drum 66 and raises the grab take-up mechanism 40. As the grab take-up mechanism 40 approaches uppermost position, upward movement of cup member 46 is then restrained in a conventional manner and the clamping member 45 is raised above the cup member 46 whereupon an air stream is directed through the conventional dial to blow the welt being formed between the cup member 46 and clamp member 45. By this time, the high surface of cam 96 will have engaged the follower 97 on the bell crank 100 to cause shield 99 to move the ratchet pawl 80 out of engagement with the ratchet wheel 75 and permit the grab take-up mechanism 40 to slide down the guide rods 51, 52, by gravity, to thus provide a uniform tension on the hose being knit on the knitting machine. The present invention is also preferably used in conjunction with a conventional stop motion mechanism which is preferably of a type known as a "Safety Controller" manufactured by Stop Motion Devices, Incorporated, Brooklyn, New York and operates substantially in the manner of an electric controller disclosed in U. S. Patent No. 2,490,936, dated December 13, 1949 and issued to Edward Vossen. Therefore, only a brief description of the conventional stop motion mechanism will be given.

The stop motion controller is designated at 130 and its housing is fixed on the upper horizontal portion 15 of the knitting machine (Figures 7 and 12). The controller 130 has an oscillatable shaft 131 (Figure 12) extending outwardly therefrom on which a reset arm 132 is fixedly mounted and which has an outwardly extending portion 133 fixed thereto adjacent the shaft 131. The outwardly extending portion 133 is engaged by and activates a control rod 134 (Figures 7 and 12) which is pivotally connected to one end of a trigger 135 pivotally secured to the frame 15, as at 136. The trigger 135 and connections therefrom to the driving pulley of the machine may be of substantially the type disclosed in a patent to Lockhead, No. 1,727,171 dated September 3, 1929. The trigger 135 is adapted to, at times, engage one end of a trip arm or lever 140 fixed on a vertically disposed shaft 141 oscillatably mounted in the horizontal portion 15 and which has a knock-off lever, not shown, beneath the plate 15.

As disclosed in said Patent No. 1,727,171, when the trigger 135 releases the trip arm 140, the latter knock-off lever is adapted to engage the usual driving pulley of the knitting machine to restrain the driving pulley from rotation to stop the machine upon the trip lever 140 being rotated, with the shaft 141, in a counterclockwise direction in Figure 7 by a tension spring 142. Counterclockwise movement of trip lever 140 (Figure 7) is permitted upon the trigger 135 being tripped as the result of a signal being received in the safety controller 130 to rotate the shaft 131 along with the reset arm 132 in a clockwise direction in Figure 12 to thus move the control rod 134 toward the bottom of Figure 7 or from right to left in Figure 12. It might be stated that the safety controller 130 is controlled by electric signals received from various parts of the machine when the machine is not functioning properly and may be reset after correcting the difficulty in the knitting machine by rotating the reset arm 132 in a counterclockwise direction in Figure 12.

A conventional pattern chain 150 is mounted on a plurality of sprocket wheels 151 journaled on a bracket 152 (Figure 5) secured to the lower portion of the base plate 10 of the knitting machine. One run of the pattern chain 150 extends upwardly through the base 10 and the other run thereof extends past the front of base 10 where the pattern chain 150 engages a sprocket 155 (Figures 5 and 6) which is driven in a step-by-step conventional manner by a ratchet wheel 156 (Figure 6) journaled on the main shaft 157 of the knitting machine. It is well known, how the pattern chain 150 controls the various instrumentalities of the knitting machine as well as reciprocatory or circular motion of the needle cylinder 20 and, therefore, a further description thereof is deemed unnecessary.

The parts heretofore mentioned are all common and conventional parts of a Scott & Williams model "KN" knitting machine with a grab take-up attachment and it is with such an arrangement or a similar arrangement that the present invention is adapted to be associated. However, it is to be understood that the principles of this invention may be applied to other types of circular knitting machines.

Detailed description of invention

The pattern chain 150 is provided with suitable side lugs or cam members 160 (Figure 6) which are in vertical alignment with a cam member 161 fixed on the upper end of a lever arm 162 oscillatably mounted intermediate its ends, as at 163, on a support bracket 164 fixed to the frame member 14 of the knitting machine. The lower end of lever arm 162 has the front end of a control rod 165 fixed thereto which extends rearwardly between the frame members 13 and 14 and slidably penetrates a downwardly extending bearing member 166 loosely mounted on the oscillatable shaft 82 and having an upwardly extending arm 170 thereon whose upper end is fixed to a bracket

171 fixedly mounted on the frame member 14. Bracket 171 also supports the medial portion of the oscillating shaft 82.

The outer end of the connecting rod 165 engages the lower arm of a bell crank 173 (Figure 5) oscillatably mounted on the oscillating shaft 82 and the opposite arm of which has connected thereto one end of a Bowden wire 175, suitably encased in a housing or flexible conduit 176. The Bowden wire 175 extends downwardly (Figure 5) beneath the lower frame 10, beneath the needle raising cylinder 30 and upwardly again to where the conduit 176 therearound is clampingly secured to the bracket 31, as by a clip 177 (Figures 2, 3 and 4).

The Bowden wire 175 extends out of the conduit 176 and the upper end thereof is connected, as at 180, to the front end of a lever arm 181 oscillatably mounted intermediate its ends, as at 182, on the gear cover or housing 95. The rear portion of lever arm 181 is twisted to form a flat portion to which a substantially inverted U-shaped bracket 183 is fixedly secured and between the downwardly extending legs of which a pair of normally open electrical switches 185, 186 are fixedly mounted. The left-hand or rear end of the lever arm 181 (Figures 2 and 3) is urged downwardly by a tension spring 190 whose upper end is connected to the lever arm 181 and whose lower end is connected to the bracket 68. The inner ends of the switches 185, 186 have respective control or actuating arms 191, 192 which loosely penetrate the outer wall of the cover or bracket 95, terminate in close proximity to the gear 71 and have substantially Z-shaped bunters 193, 194 fixed on their inner ends.

The substantially Z-shaped bunters 193, 194 on the respective actuating arms 191, 192 are laterally spaced apart and are normally spaced inwardly of the path of travel of a circularly spaced series of switch-closing cams, projections or pattern conformations 200, 201 and 202 (Figures 10 and 11) which are integral with respective plates 203, 204 and 205 secured on a base plate 206, as by screws 207. The base plate 206 is fixed on the outer face of the gear 71, as by screws 210, which gear may be also termed as a movable member movable in unison with or in timed relation to the take-up 40.

Referring to Figure 16, it will be noted that corresponding sides of the switches 185, 186 have respective wires 215, 216 connected thereto which are connected at their opposite ends to a common lead wire 217 leading to an electrical plug 218 which may be connected to a suitable source of electrical energy, not shown. The other sides of switches 185, 186 have respective wires 220, 221 leading therefrom to respective windings 222 and 223 of a reversible electric motor 225 (Figures 7, 16 and 9). The reversible motor 225 is preferably of the synchronous type manufactured by Telechron of Ashland, Massachusetts.

The reversible motor 225 is fixed to one side wall of a box-like housing 227, as by screws 228 and 229 (Figure 8). The screw 229 is a shoulder screw and also oscillatably supports the medial portion of a lever arm or control finger 230. The reversible motor 225 is also provided with a gear reduction housing 231 having suitable gearing therein, not shown, for reducing the speed of an output shaft 232 extending through the casing or box 227. The shaft 232 of the reversible electric motor 225 has an eccentric cam 235 fixed thereon by a set screw 236 (Figure 9) and on which a contact pointer or wiper 240 is fixedly secured, as by a screw 243 (Figure 9) and which rotates with the eccentric cam 235 and the shaft 232. The screw 243 also serves as a spring anchor for the upper end of a relatively light tension spring 245, the lower end of which is suitably secured to the casing or housing 227, as at 246 (Figure 8).

Referring to Figure 16, it will be noted that the coils 222, 223 of the reversible motor 225 are connected by a common wire 250 and one end of a wire 251 is suitably secured to the terminal of the coil 222 to which the wire 250 is connected. The other end of wire 251 is con-

nected to one side of a normally closed stop-motion actuated switch 252 (Figures 7, 12 and 16) mounted on the stop motion controller switch 130. The other side of switch 252 has a wire 254 leading therefrom to the electric plug 218. The electric switch 252 is provided with an actuating arm 255 (Figures 7, 12 and 16) which is in alignment with the reset arm 132 of the stop motion controller 130. Thus, upon the stop motion controller 130 being activated to swing the reset arm in a clockwise direction in Figure 12, the outer end of the activating arm 255 of the switch 252 is engaged and moved by the reset arm 232 to thus break the circuit between the wires 251, 254.

An insulated bar 260 (Figures 7, 8 and 9) is suitably secured to the box 227 above the cam 235 and has one end of a wire 261 fixedly secured thereto, as by a screw 262. The opposite end of the wire 261 (Figure 16) is connected to a terminal on the stop motion controller 130 and, upon this wire 261 being engaged or grounded to the machine through the leaf member 240 engaging the screw 262, the stop motion controller 130 is activated by means disclosed in said Patent No. 1,727,171 to thus move the reset arm 132 into engagement with the actuating arm 255 of the switch 252 and to thereby stop the machine and break the circuit to the coils 222, 223 of the reversible electric motor 225 in the event either of the switches 185, 186 is closed.

The outer end of the control finger 230 (Figure 8) has a plurality of holes 270 therein in any one of which the lower end of a tension actuating rod 271 is pivotally mounted. The rod 271 extends upwardly in Figures 1, 8 and 13 and its upper end slidably penetrates a guide member 272. Guide member 272 is a part of a yarn tension device broadly designated at T. Guide member 272 is fixed on a yarn tension support bracket 273 suitably secured on an arm 274 mounted on the post 13. The connecting rod 271 has block 275 (Figures 13, 14 and 15) adjustably secured thereon in which the lower end of an activating link 276 is fixedly secured. The upper end of the link 276 is bent to form a flat portion against which the centermost of three spaced legs 277 of a pivoted yarn guide bracket 280 is urged by a spring 282.

The yarn guide bracket 280 is oscillatably mounted adjacent opposite ends on the yarn tension support bracket 273 and the outwardly extending legs 277 thereof are urged in a clockwise direction, in Figure 14, by the tension spring 282, the upper end of which is fixedly secured on an upstanding post 283 suitably secured in the yarn tension bracket 273. The lower end of the tension spring 283 is suitably secured in a tail portion 284 extending outwardly from the yarn guiding bracket 280.

The arms 277 of the yarn guide bracket 280 are bifurcated at their outer ends and each has a yarn guiding eye 285 resiliently secured therein. All three of the eyes are in alignment. The yarn tension support bracket 273 also suitably supports a first yarn tension brake or restraining roller 290 and a second yarn tension brake or restraining roller 291 thereon. The rollers 290, 291 straddle the centermost guide eye 285. Although the yarn tension brakes 290, 291 are formed of a smooth material, such as porcelain, it is well known that the more surface contacted by a yarn the more tension will be applied thereto and it is on this principle that this variable yarn tension operates. It is evident, by referring to Figure 15, that, if the yarn guide eyes 285 are moved upwardly the yarn Y would contact more of the surface of the yarn braking members 290, 291 to also increase the amount of yarn extending between the distal eyes 285 to thus increase the tension on the yarn Y after it leaves the yarn braking drum 291 adjacent the yarn guide eye 285. Conversely, if the yarn guide eyes 285 are lowered below the position shown in Figure 15, less surface on the braking drums 290, 291 is engaged by the yarn Y to relieve the tension on the yarn Y as it leaves the last yarn guiding eye 285.

It might be stated that the gear 71 and the pattern chain 150 each make one complete revolution during the knitting of each hose on this type of machine and the hose are knitted from welt or top to toe. It is to be understood that there could be any number of cam members, such as 200, 201, 202 on the gear 71 for measuring the hose and correcting the tension in the yarn Y any number of times during the knitting operation. For purposes of simplicity, only three such cams are shown and the hose manufactured on this type knitting machine is thus measured three times during the knitting of the leg portion thereof.

Method of operation

During the knitting of a lady's hose the position of the grab take-up attachment along the guide rods 51, 52 determines the position of the gear 71 and, as the length of the knitted hose increases and the grab take-up moves, by gravity, down the guide rods 51, 52, the gear 71 is rotated, by weight 123, in a clockwise direction in Figures 2 and 10, so the cam members successively 200, 201 and 202 pass over the Z-shaped abutments 193, 194 on the electric detector switches 185, 186.

It is apparent that the number of lugs 160 on pattern chain 150 should correspond to and should be spaced to correspond with the projections 200, 201, 202 on the measuring wheel or gear 71. This indicates that there are three of the lugs 160 spaced along pattern chain 150 in this instance. As each successive lug 160 engages cam 161, this rocks lever arm 162 in a clockwise direction in Figure 5 to move rod 165 rearwardly against bell crank 173.

Clockwise movement thus imparted to bell crank 173 pulls the Bowden wire 175 through its casing 176 to thus move the lever 181 (Figure 2) in a clockwise direction to move the detector switches 185, 186 and their Z-shaped abutments 193, 194 (Figures 10 and 11) outwardly relative to the center of the gear 71. If the hose H is of the proper length at this first measuring point, indicated by the dotted line 300 in Figure 17, the Z-shaped abutments 193, 194 will pass adjacent opposite sides of the projection or cam 200 and the detector switches 185, 186 will remain opened.

Since the hose H is of the proper length at the point indicated by the dotted line 300 (Figure 17) neither of the Z-shaped abutments 193 and 194 will engage the cam member 200 so the yarn guiding eyes 285 remain in the same position relative to the braking drums 290, 291. The lug 160 then moves out of engagement with cam 161 so spring 159 (Figure 5) and 190 (Figure 2) return the parts to their original position.

As the next succeeding lug 160 engages the cam member 161 on the lever arm 162 a course at a point, such as indicated by the broken line 301, on the hose H should be knitted and the lever 181 in Figure 2 is again moved in a clockwise direction to again cause the Z-shaped abutments 193, 194 on the detector switches 195, 196 to move upwardly and, if the length of the hose being knit is too short; that is, the displacement between take-up 40 and the upper end of the needle cylinder 20 is less than desired for the number of courses knitted, the cam member 201 will be in alignment with the Z-shaped abutment 194, since the gear 71 will not have turned a sufficient amount so the cam 201 will be positioned between abutments 193, 194. As the abutment 194 is raised by the arm 181, the arm 192 on the switch 186 will be moved by the cam 201 (Figure 10) to close detector switch 186 and complete a circuit (Figure 16) through the wire 217, wire 216, the switch 186, wire 221, through the coil 223 of the reversible electric motor 225, through wires 250, 251, switch 252 and wire 254 to energize coil 223 and drive the shaft 232 and cam 235 in a counterclockwise direction in Figure 8. Upon the shaft 232 and cam 235 being rotated in a counterclockwise direction in Figure 8 the lever 230 also moves slightly in a counterclockwise direc-

tion to permit the rod 271 to move downwardly and to thus permit the spring 282 to lower the yarn guiding eyes 285 and to correspondingly slightly decrease the tension on the yarn Y passing from the yarn tension device to the corresponding yarn feeding finger 24. It is apparent that this causes the knitting machine to knit looser stitches than it had previously knit so as to compensate for the shorter length of fabric by the time the hose is knit to, say, the dotted line 302 in Figure 17.

Upon the next succeeding lug 160 engaging the cam surface 161 on the lever 162 (Figure 2) to again raise the detector switches 185, 186 and the Z-shaped abutments 193, 194, they will again move adjacent opposite sides of the cam 202, provided that the hose H is the proper length. However, if the length of the hose between the line 301 and 302 in Figure 17 is longer than it should be in proportion to the number of courses knitted therebetween, the cam 202 (Figure 10) will be engaged by the abutment 193 on the arm 191 of the switch 185 to cause current to flow from the wire 217 (Figure 16), through wire 215, switch 185, wire 220, the coil 222 of the electric motor 225, wire 251, switch 252 and wire 254 to energize the coil 222.

The coil 222 then causes the shaft 232 and cam 235 to turn in a clockwise direction in Figure 8 to thereby move the lever 230 in a clockwise direction. Moving the arm 230 in a clockwise direction will cause the rod 271 to raise the yarn guiding eyes 285 higher than they previously were relative to the restraining rollers 290, 291 (Figure 15) so the yarn Y will engage more of the periphery of the drums 290, 291 to create more tension on the yarn Y between the yarn tension device T and the corresponding yarn feeding finger 24. With more tension on the yarn Y smaller or shorter stitches will be formed in succeeding courses to compensate for the excessive length of the hose in preceding courses.

It is apparent that the extent to which the tension on the yarn Y may be varied to compensate for undesirable lengths of successive portions of a knitted article or hose is limited. For example, if an excessive amount of tension is applied to the yarn, the yarn would break and, on the other hand, if the yarn were excessively slackened, it is apparent that this would cause the formation of excessively large stitches in the knitted article which would create an undesirable streaked appearance in the knitted article which would be particularly noticeable at the first course knitted after such compensative slackening of the yarn had occurred.

If the yarn tension device T tends to apply an excessive amount of tension to the yarn Y or, conversely, tends to excessively slacken the yarn Y as it is fed to the needles, this indicates that the position of the conventional stitch cams, not shown, relative to the sinkers in the sinker cap 21 is such that the general length of stitches being formed is either substantially less or substantially greater than the optimum length they should be for producing an article of a predetermined length. In this instance, the grab take-up 40 would take up the hose or article H at a rate either slower or faster than it should be proportionate to the rate of rotation of the needle cylinder 20. Consequently, it would then be necessary to make corrective adjustments in the usual adjustment screws provided in the arm 56 (Figure 1) to thereby change the range of vertical movement of the sock horn 30 as effected by the usual cams on the main pattern drum 60 and, as is well known in the art, vertical movement of the sock horn 30 imparts corresponding vertical movement to the sinker cap 21 to correspondingly regulate the displacement between the conventional stitch cams, not shown, and the sinker cap 21 to thereby control the general length of the stitches formed by the knitting instrumentalities.

It is apparent, therefore, that any excessive variations in the tension in the yarn be promptly detected by the operator in order to insure that each completed article is

of the desired length in proportion to the number of courses therein and to prevent the knitting of faulty fabrics. This is the reason why the switch 252 (Figures 12 and 16) is interposed in the electrical circuit to the coils 222, 223 of the reversible motor 225 and operates in conjunction with the stop motion controller 130. In order to stop the machine in the event of a tendency of the tension on the yarn to vary excessively, the leaf spring contact 240 (Figures 8 and 9) is provided on the eccentric cam 235 and functions as follows:

As heretofore stated, when the length of the article being knit is less than it should be at a detecting period the element 194 (Figures 3 and 10) on the actuating arm 192 of detector switch 186 engages a corresponding one of the projections 200, 201, or 202 thereby causing the cam 235 to rotate in a counterclockwise direction in Figure 8 which, in turn, lowers the rod 271 (Figures 1, 8, 11, 14 and 15) to cause compensative slackening of the yarn Y. However, if such compensative slackening exceeds a predetermined amount, the cam 235 (Figure 8) could rotate in a counterclockwise direction to such an extent that the lowest point on the cam 235 would move beyond engagement with the lever 230 and would cause movement of the lever 230 in a direction opposite from the desired direction so the tension in the yarn would be increased instead of decreased. However, excessive rotation of the cam 235 in the counterclockwise direction is limited, since the right-hand end of contact 240 in Figure 8 will move upwardly and engage the contact or terminal 262 before or at substantially the same time that the lowest point on the cam 235 engages the follower arm 230.

Since the contact arm 240 is grounded to the machine, it is apparent that movement of the contact arm 240 against the terminal 262 grounds the circuit to the stop motion controller 130 to cause the reset arm 132 to swing upwardly in Figure 12 to not only stop the machine, in the manner heretofore described, but to also open the switch 252 and break the circuit to the coil 223 of the electric motor 225 (Figure 16). The contact arm 240 (Figure 8) may function to complete the circuit to the controller 130 in the same manner in which the switches 53 in Figure 5 of said Patent No. 2,490,936 function and, accordingly, a detailed description of the manner of operation of the controller 130 is deemed unnecessary.

The operator may then make any necessary adjustments in the screws carried by said arm 56 (Figure 1), return the cam 235 to the neutral position shown in Figure 8 and also return the reset arm 132 to the position shown in Figure 12 before the machine is again started.

It is apparent that it is necessary to loosen the screw 236 (Figure 9) in the cam 235 in order to adjust the cam 235 relative to the shaft 232 of the electric motor 225, after which the screw 236 is again tightened. The spring 245 (Figures 8 and 9) is provided so that, if the screw 236 is not tightened sufficiently against the shaft 232, the spring 245 will then quickly impart rotation to the contact wiper 240 and the cam 235 in either direction about the shaft 232, depending upon the position of the cam 235 at the time that the screw 236 becomes loosened, so that one end of the contact wiper 240 will be quickly moved into engagement with the terminal 262 to ground the circuit to the controller 130 and to thereby stop the machine.

Also, as heretofore stated, when the length of a portion of the article or hose being knitted exceeds the desired amount in proportion to the number of courses knitted, the element 193 on the actuating arm 191 of the detector switch 185 will engage a corresponding one of the projection 200, 201 or 202 on the gear 71 (Figures 10 and 11) to effect rotation of the cam 235 in a clockwise direction in Figure 8 thereby imparting corresponding clockwise movement to the follower arm 230, raising rod 271 and moving the eyes 285 (Figure 17) upwardly relative to the restraining rollers 290, 291 to compensatively increase

the tension on the yarn Y. Here again, if the cam 235 tends to rotate excessively to where it would tend to cause the yarn Y to be tightened excessively, with possible resultant breakage of the yarn, the contact arm or wiper 240 again engages the terminal 262 to close the circuit to the controller 130 to stop the machine in the manner heretofore described.

It is thus seen that I have provided a simple and effective automatic apparatus for controlling tension in yarn as it is fed to the needles of a knitting machine wherein the variations in the tension on the yarn are determined by the actual length of successive portions of each successive article being knit in proportion to the number of revolutions made by the needle cylinder during the knitting of each of said portions. It is also seen that I have provided means for automatically stopping the knitting machine in the event of the conventional stitch-length controlling elements of the knitting machine being improperly adjusted to the extent that the stitches formed by the knitting instrumentalities from course to course may be too long or too short and cause the fabric to be taken up slower or faster, respectively, than is desired to maintain the fabric of the desired nominal length with stitches of the desired length in each course of the fabric.

It is apparent that the conventional stitch-length controlling elements of the machine can only determine normal or approximate length of the fabric being knit and the improved apparatus determines the actual length of each successive article.

In the drawings and specification, there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

I claim:

1. In a circular knitting machine having means for knitting seamless tubular fabric thereon, said machine having means for tensioning a knitting yarn enroute to the needles thereof and also having means for applying tension to the fabric being knitted; the combination of a control apparatus for actuating the tensioning means to compensatively increase or decrease the tension on the yarn, means for detecting the length of the fabric knitted at predetermined intervals, and means for operating said control mechanism upon said detector means detecting a fabric length lesser or greater than a predetermined optimum length of said fabric formed in proportion to a predetermined number of courses knit to thereby correspondingly compensatively decrease or increase the tension on the yarn for maintenance of uniform overall length.

2. A structure according to claim 1 wherein said tensioning means includes at least two pivoted yarn guides and a stationary element in engagement with the yarn in the interval between said yarn guides, and means for stopping the machine upon movement of said pivoted yarn guides beyond prescribed limits in either direction.

3. In a circular knitting machine having knitting instrumentalities including a needle cylinder, said machine also having means for tensioning a knitting yarn enroute to the knitting instrumentalities and means for urging the fabric being knit downwardly through the needle cylinder, a control apparatus including detector means adapted to be influenced by the length of successive predetermined portions of the fabric knit in the event of any tendency of the length of such portions of the fabric to vary either side of a predetermined optimum in proportion to a given number of courses knit, and means under control of the detector means for actuating the tensioning means to compensatively increase or decrease the tension on the yarn to rectify the length of the fabric upon knitting a portion succeeding any one of said portions whose length is longer or shorter than said optimum.

4. A structure according to claim 3 wherein said tensioning means includes at least two pivoted yarn guides and a stationary element in engagement with the yarn in the interval between said yarn guides, and means for stopping the machine upon movement of said pivoted yarn guides beyond prescribed limits in either direction.

5. In a circular knitting machine having knitting instrumentalities including a needle cylinder, said machine also having means for tensioning a knitting yarn enroute to the needle cylinder and means movable downwardly from adjacent the upper end of the needle cylinder for maintaining tension in the fabric being knit; the combination of automatically operable means for measuring the displacement between the upper end of the needle cylinder and said take-up means at predetermined intervals, and means automatically operable for actuating the tensioning means in response to said measuring means to compensatively decrease or increase the tension on the yarn in the event of the displacement between the take-up means and the upper end of the needle cylinder being correspondingly lesser or greater than the prescribed displacement should be relative to the number of courses knitted at the time said displacement is measured.

6. In a circular knitting machine having a needle cylinder and other means for knitting tubular fabric, said machine also having means for tensioning a knitting yarn enroute to the needle cylinder and means for pulling the fabric being knit downwardly through the needle cylinder under predetermined tension; apparatus for controlling the length of successive sections of the fabric being knit comprising a reversible motor for actuating the yarn tensioning means, a movable member operatively connected with and movable in unison with said fabric pulling means, said movable member having spaced conformations thereon, movable detector means normally spaced adjacent the path of travel of said movable member, means operable automatically at predetermined intervals for moving said detector means into the path of travel of the conformations on said movable member, the spacing of said conformations corresponding to required lengths of fabric sections to correspond with said intervals, and means for operating said motor in either direction upon any one of said conformations being engaged by said detector means to correspondingly actuate the tensioning means and compensatively vary the tension on the yarn to thereby insure a predetermined length in the fabric.

7. In a circular knitting machine having knitting instrumentalities including a needle cylinder, means for tensioning a knitting yarn enroute to the needle cylinder, and take-up means for pulling the fabric being knit through the needle cylinder while maintaining tension therein; the combination of a reversible motor for actuating the yarn tensioning means, a movable element operatively connected with and movable in unison with said take-up means, a plurality of spaced projections on said movable element and being spaced from each other in accordance with the prescribed spacing of predetermined courses in the fabric being knit, movable detector means disposed adjacent the path of travel of said projections, pattern controlled means for moving said detector means into the path of travel of said projections at predetermined intervals, said intervals corresponding to the number of revolutions of the needle cylinder involved in knitting the portions of the fabric between the courses represented by the projections on said movable element, said movable detector means being so arranged as to clear the immediately adjacent projection on the movable member when actuated in the event of the length of the fabric properly conforming to the number of courses knitted, said detector means being arranged to engage the immediately adjacent projection upon the length of the corresponding portion of the fabric knitted

being incorrect in proportion to the number of courses knitted, and means responsive to engagement of any one of said projections by said detector means for operating the motor in a corresponding direction to correspondingly actuate the tensioning means and thereby compensatively vary the tension on the yarn to ultimately rectify the length of the fabric being knit.

8. A structure according to claim 7 wherein said movable element is in the form of a rotary element journaled on said machine adjacent the take-up means and wherein said projections are fixed to the rotary element and arranged in circularly spaced relationship thereon.

9. A structure according to claim 7 wherein said movable element is in the form of a gear and wherein the projections are fixed to one side of said gear and are arranged in circularly spaced relationship thereon, a pulley journaled on said machine and having a gear thereon meshing with the first-named gear, a pliable element having one end connected to said take-up means and having its other end connected to said pulley, and means tending to urge said pulley in a direction such as to take up the pliable element as it is payed out by the take-up means whereby said pulley imparts corresponding rotation to said gear.

10. A structure according to claim 7 wherein the tensioning means comprises a stationary element in engagement with the yarn and a pair of yarn guides movable astride the stationary element, a shaft driven by said reversible motor, an eccentric cam fixed on said shaft, a pivoted follower arm bearing against said cam and coupled to the yarn guides of the tensioning device whereby rotation of said cam in either direction imparts corresponding movement to said follower arm to correspondingly vary the position of the yarn guides relative to the stationary element.

11. A structure according to claim 10 wherein said knitting machine has a stop motion, and means for actuating said stop motion to stop the machine upon movement of said cam beyond prescribed limits in opposite directions.

12. A structure according to claim 10 wherein said knitting machine has an automatic stop motion, and means operable automatically upon actuation of said stop motion for also stopping said motor.

13. A structure according to claim 10 wherein said knitting machine has an electrically operable stop motion, a contact wiper fixed to and rotatable with said eccentric cam, a contact positioned in the path of travel of said wiper and being engageable by the wiper upon rotation of said cam beyond prescribed limits in opposite directions, and said wiper and contact being interposed in an electrical circuit to said stop motion whereby said wiper engaging the contact actuates said stop motion to stop the machine.

14. In a circular knitting machine having knitting instrumentalities including a needle cylinder, means for tensioning a knitting yarn enroute to the needle cylinder, and take-up means for pulling the fabric being knit through the needle cylinder while maintaining tension therein; the combination of a reversible electric motor for actuating the yarn tensioning means, a movable element driven in timed relation with said take-up means, a plurality of spaced projections on said movable element and being spaced from each other in accordance with the prescribed spacing of predetermined courses in the fabric being knit, movable detector means disposed adjacent the path of travel of said projections, means for moving said detector means into the path of travel of said projections at predetermined intervals, said intervals corresponding to the number of revolutions of the needle cylinder involved in knitting the portions of the fabric between the courses represented by the projections on said movable element, said movable detector means being so arranged as to clear the immediately adjacent projection on the movable element or member when actuated

in the event of the length of the fabric properly conforming to the number of courses knitted, and said detector means being arranged to engage the immediately adjacent projection upon the length of the corresponding portion of the fabric knitted being improper in proportion to the number of courses knitted, and means responsive to engagement of any one of said projections by said detector means for operating the motor in a corresponding direction to correspondingly actuate the tensioning means and thereby compensatively vary the tension on the yarn to rectify the length of the fabric during the knitting of a succeeding portion.

15. A structure according to claim 14 wherein said motor is provided with first and second coils for effecting operation of the motor in opposite directions, said detector means including first and second normally open detector switches interposed in electrical circuits to the respective first and second coils, a common supporting element supporting said switches, said switches having respective first and second actuating arms projecting therefrom and being spaced from each other a substantially greater distance than the width of each of said projections, said means for moving the detector means at predetermined intervals serving to move the supporting element so the actuating arms on the switches move into the path of travel of said projections, and the relative positions of the projections and the actuating arms being such that either of said actuating arms will only engage a corresponding projection when the supporting element for the switches is actuated in the event of the length of the corresponding portion of the fabric knitted being incorrect in proportion to the number of courses knitted to thereby close the corresponding switch and energize the corresponding coil to operate the motor in the corresponding direction.

16. A structure according to claim 15 wherein said movable element is in the form of a rotary element journaled on said machine adjacent the take-up means and wherein said projections are fixed to the rotary element and arranged in circularly spaced relationship thereon.

17. A structure according to claim 15 wherein said movable element is in the form of a gear and wherein the projections are fixed to one side of said gear and are arranged in circularly spaced relationship thereon, a pulley journaled on said machine and having a gear thereon meshing with the first named gear, a pliable element having one end connected to said take-up means and having its other end connected to said pulley, and means tending to urge said pulley in a direction such as to take up the cable as it is paid out by the take-up means whereby said pulley imparts corresponding rotation to said gear.

18. A structure according to claim 15 wherein said machine has an automatic stop motion thereon provided with a movable part to which movement is imparted upon actuation of said stop motion, a third normally closed switch interposed in the circuits to said coils, and means on said third switch engageable by the movable part upon actuation of the stop motion for opening the third switch to break the circuit to either of said coils if such circuit was previously completed by a corresponding one of said first and second switches.

19. In a circular knitting machine having a grab take-up mechanism for taking up the hose knit thereon and said machine having a pattern means; the combination of a variable yarn tension device, a reversible electric motor for actuating said yarn tension device to vary the tension on the yarn, signaling switches interposed in an electrical circuit to said motor and activated by said pattern means for driving said motor in opposite directions, and cam means on said grab take-up mechanism engageable by said signaling switches, when the position of the grab take-up relative to the knitting zone is out-of-time

relative to the number of courses knit, for closing the circuit to the motor to cause it to operate in either direction for compensatively actuating said tension device.

20. The method of controlling overall fabric length while knitting fabric on a circular knitting machine to proportionately correspond with the number of courses in such length which includes intermittently measuring the length of a given portion, including a plurality of courses, of the fabric and compensatively varying the tension in the yarn from which the fabric is knit during the knitting of a succeeding portion upon the measurement of said given portion varying either side of predetermined limits.

21. The method of controlling the overall length of a hose while knitting the same on a circular knitting machine wherein the machine is provided with a means for holding hose taut from the knitting instrumentalities as it is knit, said method comprising measuring the length of the hose knit at spaced intervals following knitting of a predetermined number of courses to determine whether the length of said measured portion is proper relative to the number of said courses therein, compensatively varying the tension in the yarn employed in knitting in the event of said portion being of improper length, and then knitting a succeeding portion of the hose from the compensatively tensioned yarn.

22. The method according to claim 21 including repeating the steps as prescribed substantially throughout the length of said hose.

23. The method of controlling the overall length of a fabric while knitting the same on a circular knitting machine wherein the machine is provided with a take-up for pulling the fabric away from the knitting instrumentalities as it is knit, said method comprising intermittently measuring the length of at least one portion of the fabric having a plurality of courses therein to determine whether the length of said portion is proper relative to the number of said courses therein, compensatively varying the tension in the yarn employed in knitting in the event of said portion being of improper length, and then knitting a succeeding portion of the fabric from the compensatively tensioned yarn.

24. That method of controlling the length of an article as it is knit on a circular knitting machine having yarn fed to the knitting instrumentalities thereof and having a fabric tensioning take-up means thereon, which includes intermittently determining at spaced intervals the optimum length of the article between certain prescribed courses relative to the number of intervening courses between an adjacent pair of said prescribed courses, measuring the longitudinal displacement between the knitting instrumentalities and the take-up means during the knitting of the second one of said prescribed courses in the latter pair, and varying the tension on the yarn being fed to the knitting instrumentalities to rectify any tendency in the displacement between the take-up means and the knitting instrumentalities to vary with respect to the prescribed displacement.

25. That method of controlling fabric length while knitting fabric on a circular knitting machine which comprises measuring the length of fabric at predetermined intervals and compensatively varying the tension in the yarn from which the fabric is knit during the knitting of a succeeding length of fabric upon the measurement of said length of fabric varying either side of predetermined limits.

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