July 16, 1963 J. A. PIKE ETAL 3,097,513

YARN CUTTING AND CLAMPING MEANS FOR KNITTING MACHINES

Filed Sept. 5, 1957 6 Sheets-Sheet 1

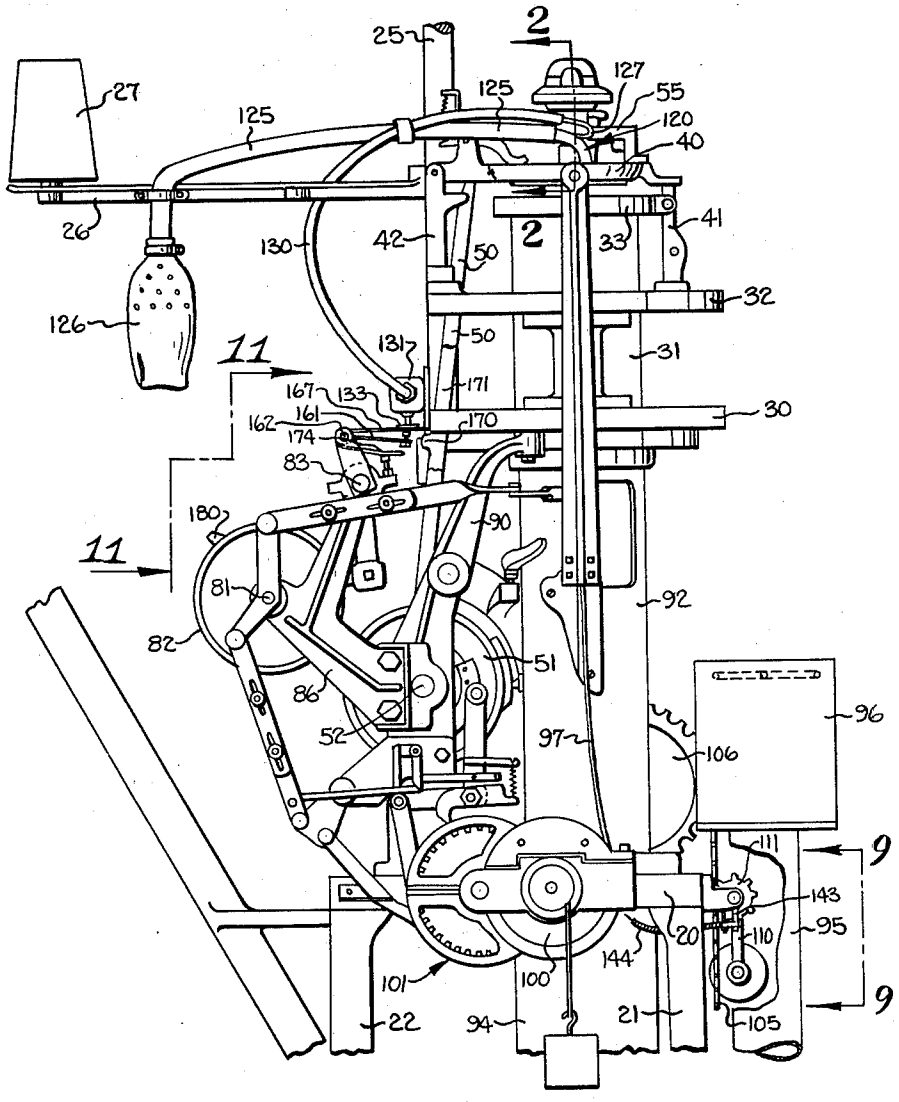


Fig-1

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YARN CUTTING AND CLAMPING MEANS FOR KNITTING MACHINES

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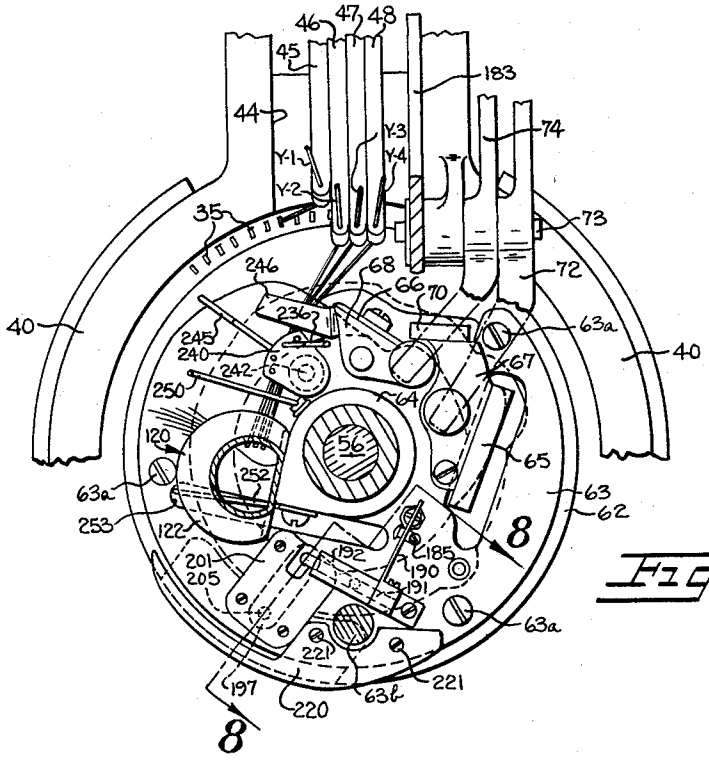


FIG-3

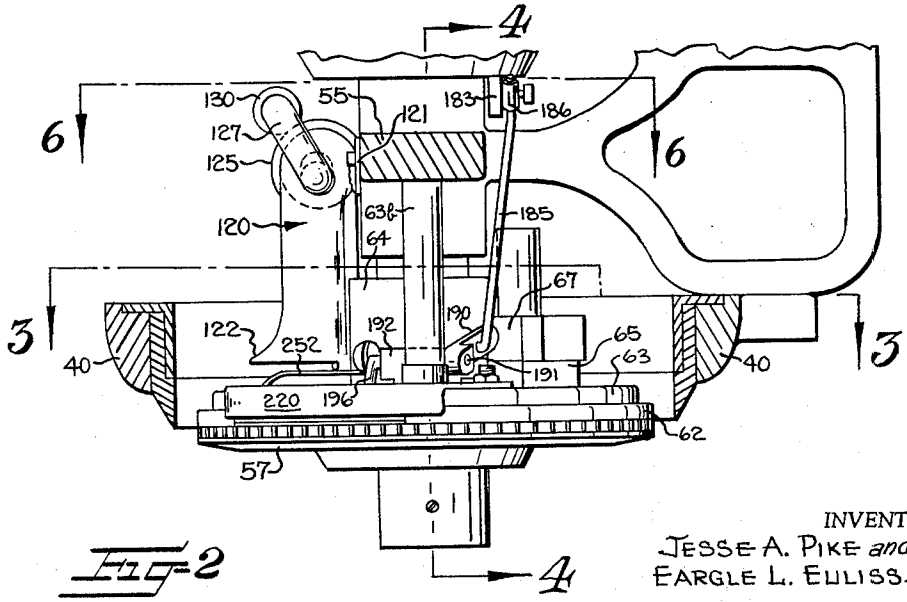


FIG-2

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YARN CUTTING AND CLAMPING MEANS FOR KNITTING MACHINES

Filed Sept. 5, 1957 6 Sheets-Sheet 3

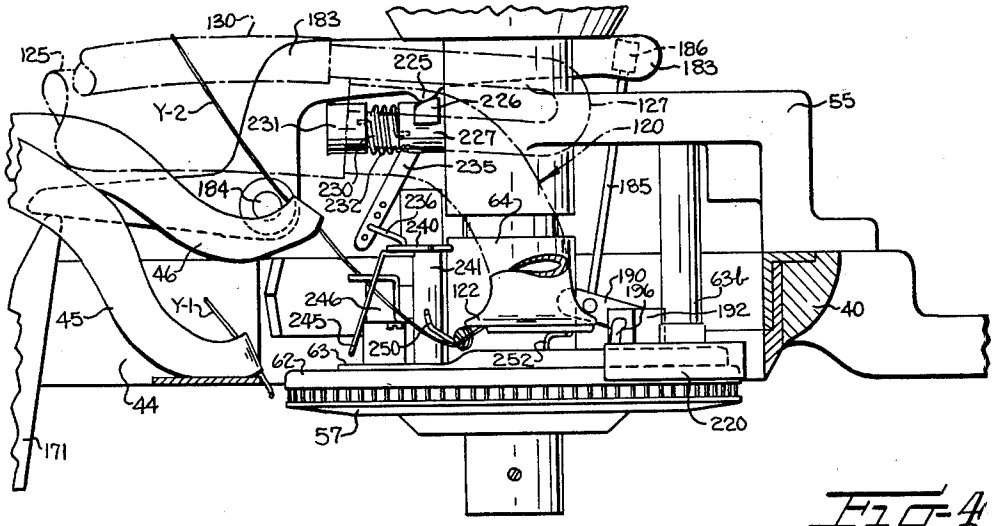


Fig-4

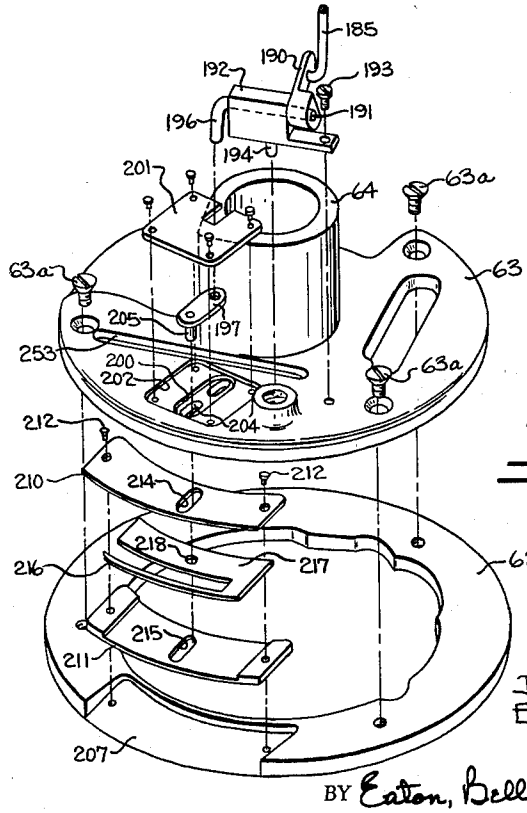


Fig-5

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YARN CUTTING AND CLAMPING MEANS FOR KNITTING MACHINES

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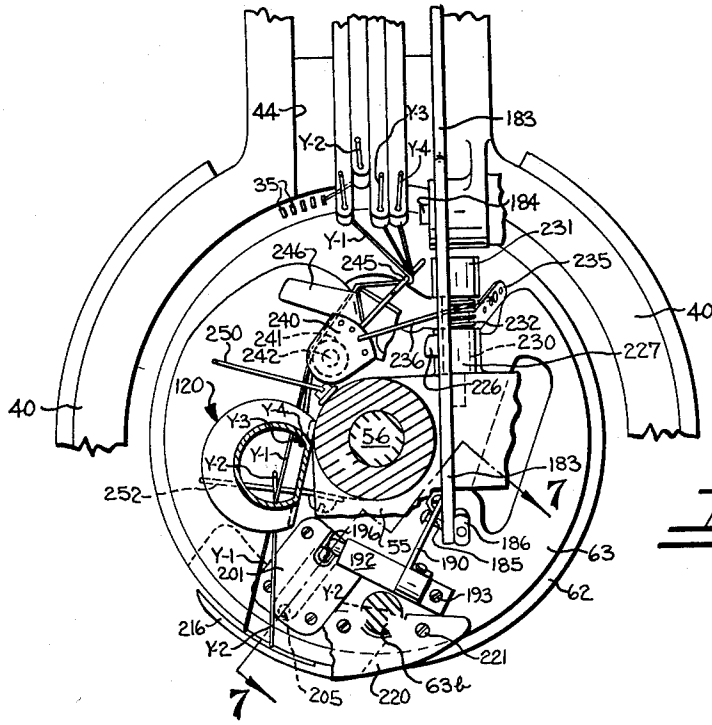


FIG-6

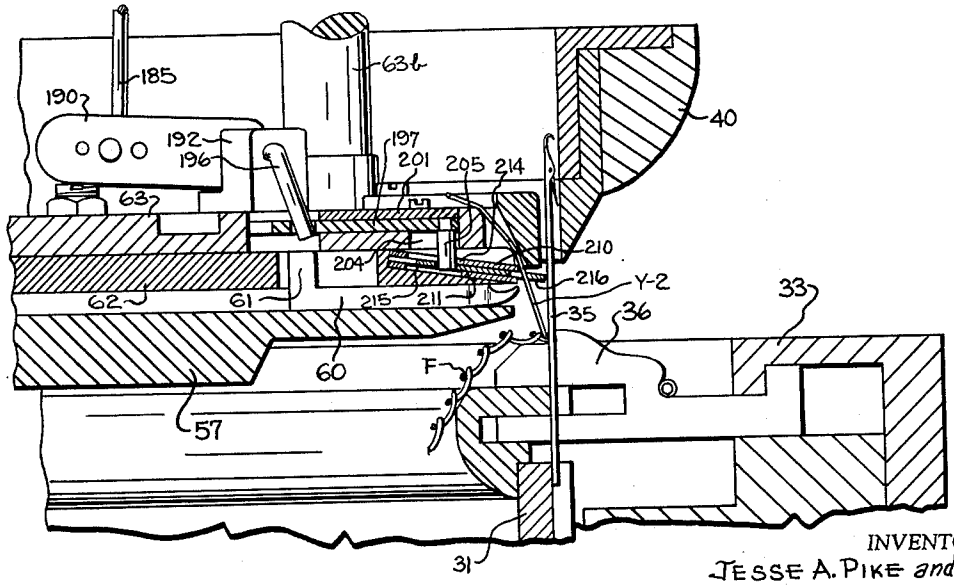


FIG-7

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YARN CUTTING AND CLAMPING MEANS FOR KNITTING MACHINES

Filed Sept. 5, 1957 6 Sheets-Sheet 5

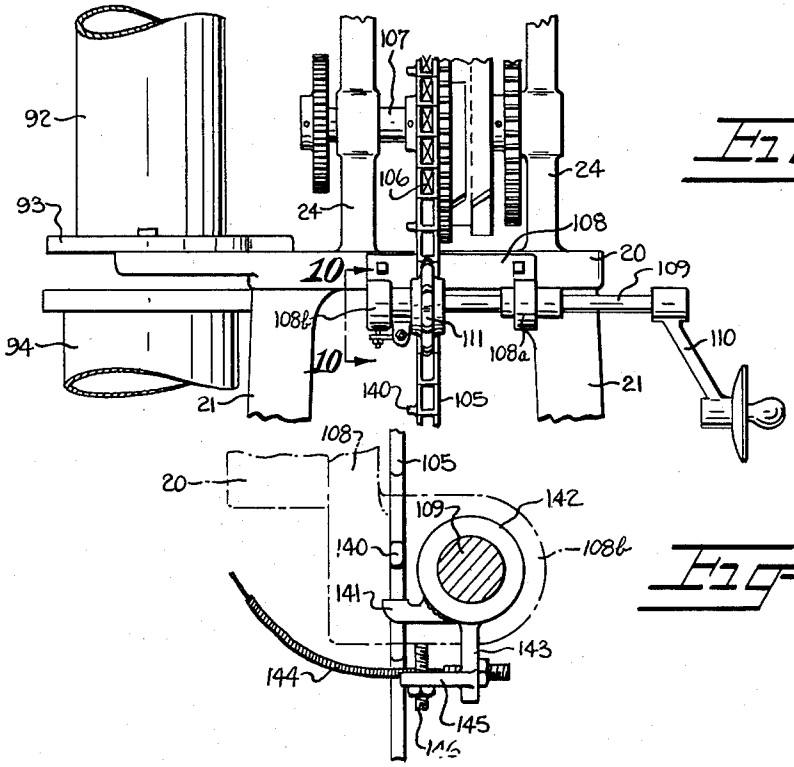


Fig-9

Fig-10

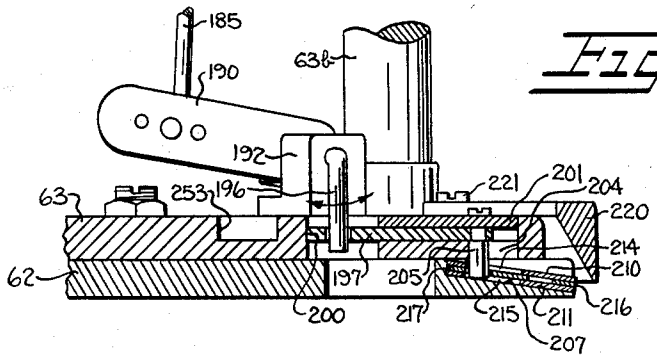


Fig-8

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YARN CUTTING AND CLAMPING MEANS FOR KNITTING MACHINES

Filed Sept. 5, 1957 6 Sheets-Sheet 6

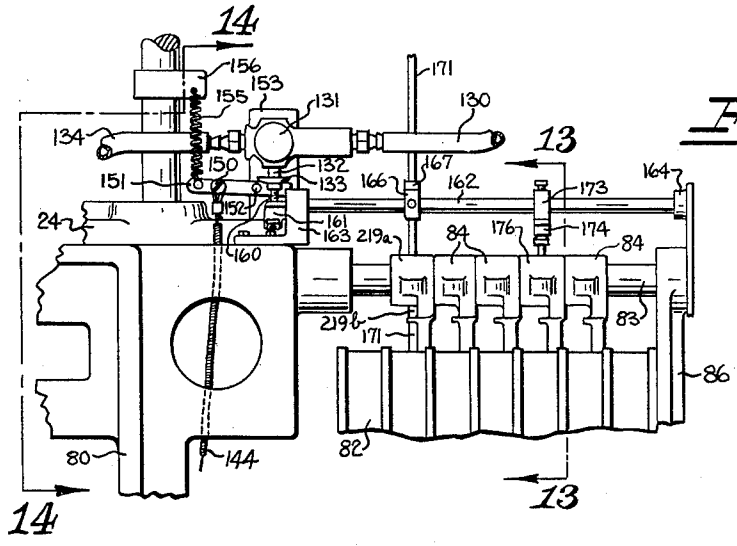


Fig-11

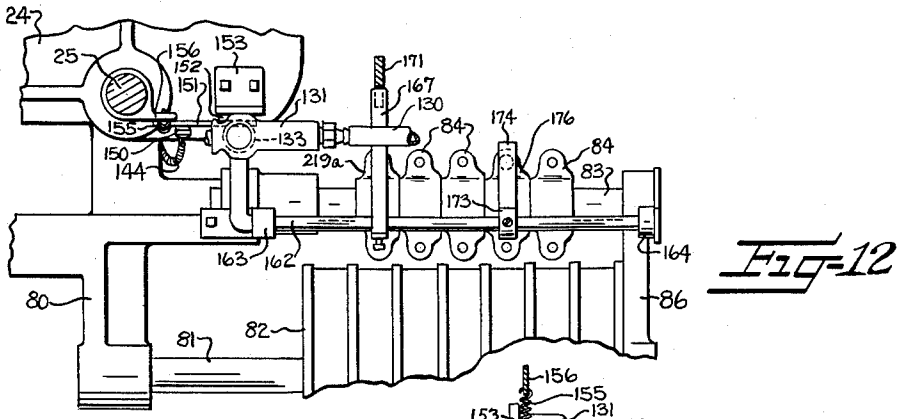


Fig-12

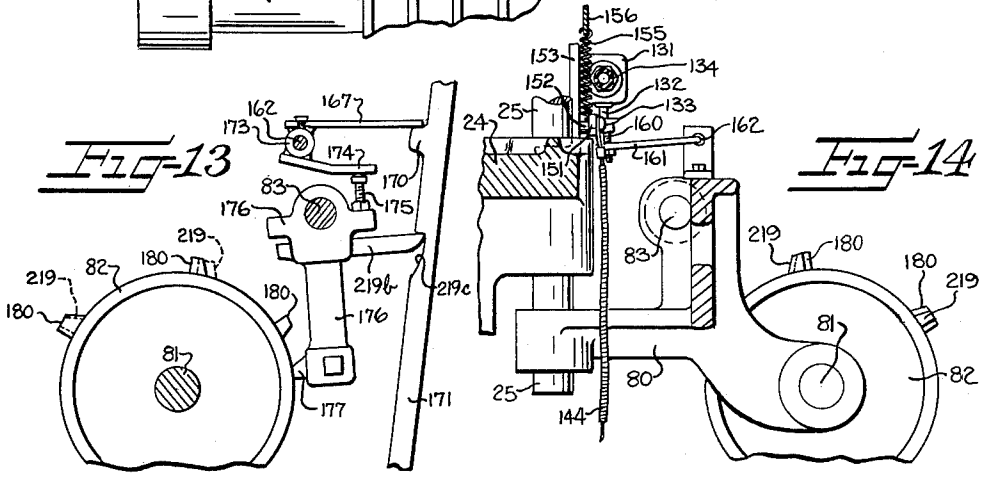


Fig-13

Fig-14

United States Patent Office 3,097,513 Patented July 16, 1963

3,097,513

YARN CUTTING AND CLAMPING MEANS FOR KNITTING MACHINES

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Filed Sept. 5, 1957, Ser. No. 682,240
1 Claim. (Cl. 66—145)

This invention relates generally to an improved yarn holding and cutting means for circular knitting machines and more especially to an improved method of and apparatus for cutting the yarn ends closely adjacent the knitted fabric when yarns are introduced to and removed from knitting position and an improved method of and apparatus for holding the yarn ends during knitting and during the cutting operation.

Present circular knitting machines are provided with a plurality of yarn feed fingers which are movable into and out of operative position for selectively feeding the yarns to circularly arranged needles in a predetermined sequence. The ends of yarn from each feeding finger are held beneath a single yarn clamp, usually a spring clip, mounted closely adjacent a single yarn cutter and both of which are fixed on top of a dial positioned inside of the circularly arranged needles. Thus, when one of the yarn feeding fingers is moved to operative position so that the needles pick up the yarn therefrom, the free end of yarn is pulled from beneath the yarn clamp with rotation of the needles, leaving a relatively long leading end, on the order of two inches, extending inside of the fabric. When the yarn feeding finger is removed from operative position, the yarn passes across the dial, beneath the clamp and is then cut by the cutter, mounted on the dial, to leave another relatively long trailing end, on the order of two inches, from the cutter to the fabric. As the needle cylinder rotates the long ends are sometimes picked up by the needles to knit again and form double stitches which are objectionable.

These relatively long leading and trailing ends of yarn in the stocking must be removed at sometime following the knitting operation because if not removed they distract from the appearance of the knitted stocking, particularly in ladies' sheer hosiery. These long ends are usually clipped to leave a relatively short end, on the order of one-quarter of an inch, during the inspecting operation. Many times, although these long ends are manually clipped, the clipped ends adhere, through static electricity, to the hose and appear in the hose after finishing.

It is the primary object of this invention to provide an improved method of and means for cutting and holding the yarn ends wherein the leading and trailing ends of the yarn are both cut closely adjacent the knit fabric to prevent having long yarn ends which must be removed by a separate operation subsequent to knitting.

It is another object of this invention to provide an improved method of and means for cutting and holding the yarn ends whereby suction means is provided to resiliently hold the free ends of the non-knitting yarns extending from the yarn feeding fingers and for removing the short section of yarn cut from the leading end of the yarn as it is introduced and which extends from the yarn cutting means to the yarn holding means.

It is another object of this invention to provide an improved yarn cutting device positioned in the edge of the usual dial, in close proximity to the circularly arranged needles and closely spaced above the fabric on the needles, as well as pattern controlled means for moving the cutting device to yarn receiving position and to cutting position to sever or cut the yarn closely adjacent the fabric.

It is a more specific object of this invention to provide suction means for the yarn ends with control means operable to actuate the suction means when desired and which suction means cooperates with an improved yarn cutting device to cut both the leading and trailing ends of yarn introduced to and removed from knitting position closely adjacent the fabric and yarn slackening means cooperating with the cutting device to provide additional yarn to be grasped by the suction means upon operation of the cutting device.

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 the upper portion of a knitting machine with the improved yarn cutting and holding means applied thereto;

FIGURE 2 is an enlarged fragmentary sectional view through the latch ring taken substantially along the line 2—2 in FIGURE 1 and showing the dial and associated parts in elevation;

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

FIGURE 4 is a vertical sectional view through the latch ring taken substantially along the line 4—4 in FIGURE 2 and showing the dial and associated parts and the suction nozzle in elevation;

FIGURE 5 is an exploded isometric view of the dial and showing the improved cutting mechanism associated therewith;

FIGURE 6 is a sectional plan view taken substantially along the line 6—6 in FIGURE 2 with some of the conventional parts being omitted;

FIGURE 7 is an enlarged fragmentary vertical sectional view through the cutter blade and a portion of the sinker cap taken substantially along the line 7—7 in FIGURE 6;

FIGURE 8 is an enlarged fragmentary vertical sectional view through the cutter blade taken substantially along the line 8—8 in FIGURE 3;

FIGURE 9 is a fragmentary front elevation of the lower portion of the knitting machine taken substantially along the line 9—9 in FIGURE 1;

FIGURE 10 is an enlarged fragmentary side elevation taken substantially along the line 10—10 in FIGURE 9;

FIGURE 11 is an enlarged fragmentary rear elevation taken substantially along the line 11—11 in FIGURE 1;

FIGURE 12 is a fragmentary plan view of the structure shown in FIGURE 11;

FIGURE 13 is a vertical sectional view taken substantially along the line 13—13 in FIGURE 11;

FIGURE 14 is a vertical sectional view looking at the left-hand side of FIGURE 11 and in the direction indicated by the line 14—14 in FIGURE 11.

Referring more specifically to the drawings, the numeral 20 indicates the base of a circular knitting machine (FIGURES 1 and 9) having the upper end of respective front and rear supporting legs 21 and 22 suitably secured thereto. The lower end of a machine frame 24 is suitably secured to the base 20 and the upper end thereof supports the lower end of a yarn supply creel post 25 which extends upwardly above the frame 24 and supports a yarn supply creel 26 (FIGURE 1) on which a plurality of yarn supply bobbins 27 may be suitably mounted.

The upper portion of the machine frame 24 also supports a lower circular bed plate 30 in which the lower end of a needle cylinder 31 is mounted, at times, to be driven to rotate and at other times to reciprocate through conventional driving gears, not shown. The needles cylinder 31 extends upwardly through a second or upper bed plate 32 spaced above the bed plate 30 and the needle cylinder 31 has the usual sinker cap 33 suitably secured to the up-

per end thereof. The needle cylinder 31 has a plurality of cylinder needles 35 mounted for vertical reciprocation in vertically extending grooves therein (FIGURE 7) which cooperates with radially movable sinkers 36 mounted for radial movement in the sinker cap 33 and positioned between each of the needles 35.

A latch ring 40 is spaced slightly above the upper surface of the sinker cap 33 and the front end thereof is supported on the upper end of a bunter post 41 (FIGURE 1) the lower end of which is fixed on the bed plate 32. The rear end of the latch ring 40 is pivotally supported on the upper end of a support post 42, the lower end of which is suitably secured to the upper surface of the bed plate 32.

The latch ring 40 is provided with a throat opening 44 (FIGURES 3 and 4) in which the front or feeding ends of a plurality of yarn feeding fingers 45, 46, 47 and 48 are mounted to feed respective yarns Y–1, Y–2, Y–3 and Y–4 to the needles 35. The yarn feeding fingers 45 through 48 are oscillatably mounted on an upstanding portion of the latch ring 40 and are normally urged downwardly at their feeding ends into the throat opening 44 and into yarn feeding position by springs, not shown. Each of the yarn feeding fingers may be raised to inoperative position by thrust rods, only one of which is indicated at 50 (FIGURE 1). The lower ends of the thrust rods at times engage a main pattern drum 51 mounted for step-by-step movement on the frame member 24 and at other times are raised by cams, not shown, on the pattern drum 51. The main pattern drum 51 is rotatably supported on a shaft 52 (FIGURE 1) the inner end of which is fixed in the frame 24.

The latch ring 40 supports the usual dial driving gear support bracket 55 in which a vertically disposed dial drive shaft 56 is mounted and which is driven through conventional bevel gears, not shown in the support bracket 55. The lower end of the dial drive shaft 56 supports and drives a dial plate 57 which is grooved radially to receive radially slidable transfer hooks 60 (FIGURE 7). The transfer hooks 60 are used in a conventional manner during the formation of a turned or double thickness fabric, such as is formed to make the welt of ladies' seamless hosiery.

The transfer hooks 60 are each provided with an upstanding tail or operating member 61 on the inner end which is guided in a dial cam ring 62 (FIGURE 5) suitably secured to the lower surface of a dial cap 63 as by screws 63*a*. The dial cap 63 has a centrally located upstanding boss 64 which is suitably secured to the bracket 55 to support the dial cap 63 in the center of the circularly arranged needles 35. The dial cap 63 is additionally supported by a support post 63*b*, the lower end of which is fixed in the dial cap 63 and the upper end of which is fixed in the bracket 55. The dial cap 63 is provided with the usual transfer hook push out cams 65 and 66 (FIGURE 3) mounted on respective vertically movable dial cam brackets 67 and 68 which are normally resiliently urged upwardly to raise the transfer hook push out cams 65 and 66 to inoperative position. A transfer hook returning cam 70 is adapted to at times move the transfer hooks inwardly to inoperative position and is fixed on the bracket 67.

The bracket 67, supporting the transfer hook push out cam 65 and the transfer hook returning cam 70, is adapted to at times be lowered by the inner end of a lever 72, oscillatably mounted as at 73 on the latch ring 40 and the outer end of which is operated by conventional linkage, not shown, from the main pattern drum 51. The bracket 68 is adapted to at times be moved downwardly by the inner end of a lever 74 oscillatably mounted as at 73 on the latch ring 40 and the outer end of which is operated by conventional linkage, not shown, from the main pattern drum 51.

The lower end of the yarn creel support post 25 extends below the frame 24 (FIGURE 14) and supports a bracket 80 in the outer end of which one end of a shaft 81 is fixed. The shaft 81 rotatably supports an auxiliary or striper pattern drum 82 driven in a conventional step-by-step manner to provide an auxiliary means, in addition to the pattern drum 51, for controlling the operation of the yarn feeding fingers 45 through 48 as well as other conventional parts of the knitting machine. The bracket 80 also supports one end of a shaft 83 on which the upper ends of conventional auxiliary control arms 84 are oscillatably mounted and the lower ends of which are adapted to engage the auxiliary pattern drum 82. The outer ends of the shafts 81 and 83 are suitably supported in a support bracket 86 (FIGURE 1), the lower end of which is fixed to an auxiliary frame member 90. The lower end of the frame member 90 is fixed on the base 20 and the upper end supports the lower bed plate 30. The frame member 90 also supports the outer end of the shaft 52 on which the main pattern drum 51 is rotatably mounted.

The knitting machine is also provided with a conventional needle cylinder raising tube or sock horn 92, the upper end of which is slidably mounted in the lower cam plate 30 and the lower end of which is slidably mounted in a bracket 93 (FIGURE 9) fixed on the base 20 of the knitting machine. The sock horn or tube 92 may be provided with a conventional grab take-up mechanism for applying tension to the fabric as it is knit. With this type of take-up a weight member, not shown, is attached to the stocking and passed downwardly through the needle cylinder 31, sock horn 92 and into a tube 94, positioned beneath the sock horn 92. The weight member releases the stocking in the lower end of the tube 94 after knitting and the stocking is forced by compressed air upwardly through a tube 95 and into a stocking receptacle 96 where it may be removed by the knitter. The weight member of the grab take-up mechanism is raised to grasp the top of the next stocking by a cable 97 wound onto a take-up drum 100. The drum 100 is operated by conventional racking mechanism, indicated broadly at 101, and which is clearly shown and described in U.S. Patent Nos. 2,625,026 and 2,709,352.

A conventional pattern chain 105 (FIGURES 1, 9 and 10) controls operation of the knitting machine and particularly movement of the pattern drums 51 and 82 and is moved in a conventional step-by-step manner by a sprocket wheel 106 mounted on a shaft 107 driven by the usual driving gears, not shown, in the frame 24. The pattern chain 105 extends downwardly from the sprocket wheel 106 to pass in front of the base 20 and over a bracket 108 fixed on the front of the base 20. The bracket 108 has outwardly extending bearing members 108*a* and 108*b* which support a shaft 109 having a crank handle 110 fixed on one end thereof and a chain sprocket 111 fixed thereon between the bearing members 108*a* and 108*b*. The chain sprocket 111 engages the main pattern chain 105 and upon rotation of the handle 110, movement may be imparted to the chain 105.

The parts heretofore described are all conventional parts of a Scott & Williams Model "KN" knitting machine equipped with a grab take-up attachment and it is with such a machine that the present invention is particularly adapted to be associated. It is to be understood, however, that the principles of this invention may be equally adaptable to other types of circular knitting machines with or without a take-up mechanism.

The present invention comprises a yarn end holding means in the form of a vacuum or suction nozzle indicated at 120. The nozzle 120 is fixed on the dial support bracket 55 as by a plate 121 (FIGURE 2) one end of which is fixed on the suction nozzle 120 and the other end of which is suitably secured to the bracket 55. The suction nozzle 120 has a flared lower free end 122 which terminates in close proximity above the upper surface of the dial cap 63. The upper end of the suction nozzle 120 has one end of a suitable flexible hose or tube 125 connected thereto (FIGURE 1), the other end of which extends to a yarn end collection bag 126 suitably secured thereto.

A suitable low pressure area or suction is provided at the flared mouth 122 of the suction nozzle 120 by an air pressure nozzle 127 (FIGURES 1 and 4). The nozzle 127 is substantially U-shaped and one leg penetrates the curved portion of the suction nozzle 120 and is suitably secured thereto as by welding while the other leg has one end of a flexible air hose or tube 130 connected thereto. The other end of the tube 130 is suitably connected to one side of an air pressure cut off valve 131 (FIGURES 11 and 12) which is provided with an operating valve stem 132 having an enlarged head 133. The opposite side of the air valve 131 has one end of a flexible air pressure hose 134 connected thereto the opposite end of which is connected to any suitable source of compressed air, not shown, to continuously supply air under pressure to the valve 131.

It might be stated that the valve 131 is of the type which is normally closed and may be opened by depresssing the valve stem 132, in a manner to be later described. When the valve 131 is opened, compressed air will pass into the tube 130, the nozzle 127, the suction nozzle 120, through the tube 125 and escape through the bag 126. The air passing through the upper portion of the suction nozzle 120 will thus create a low pressure area or suction currents adjacent the lower open flared end 122 of the suction nozzle 120.

The air pressure from the line 134, through the valve 131 and through the line 130 may remain on constantly during operation of the knitting machine, if desired, to thus create a low pressure or vacuum adjacent the flared open mouth 122 of the suction nozzle 120 so that the free ends of any yarns near the mouth 22 will be drawn up into the nozzle 120 and held therein. The amount of suction created at the mouth 122 may be controlled by varying the air pressure entering the hose 134. It has been found, however, that it is not necessary to maintain suction at the nozzle 120 except during a yarn change and therefore means have been provided to open the valve 131 and create suction currents at the mouth 122 of the suction nozzle 120 when desired. The operation of the valve 131 is controlled, through suitable linkage to be presently described, by the pattern chain 105, by the auxiliary pattern drum 82 or by the main pattern drum 51.

Operation of the air valve 131 is controlled by the pattern chain 105 by special lugs 140 (FIGURES 9 and 10) disposed on the side of certain of the chain links. The lugs 140 are adapted to engage the outer end of a lever arm 141, the inner end of which is fixed on a collar 142 mounted for oscillation on the shaft 109. The collar 142 has the inner end of control arm 143 connected thereto to the outer end of which one end of a cable or Bowden wire 144 is connected. The control arm 143 has a branch arm 145 formed integral therewith the free end of which has an adjustable abutment in the form of a screw 146 threadably mounted therein adapted to engage the bearing member 108*b* of the bracket 108 to restrict clockwise movement of the collar 142 and arms 141 and 143 in FIGURE 10. The wire 144 extends beneath the base 20 of the machine and upwardly behind the frame member 24 and the opposite end thereof (FIGURES 11, 12 and 14) is suitably connected as at 150 adjacent one end of a first valve control lever 151. The control lever 151 is oscillatably mounted intermediate its ends as at 152 on a bracket 153. The lower end of the bracket 153 is suitably secured to the upper surface of the machine frame 24 and its upwardly extending leg supports the air valve 131. The control lever 151 is normally urged in a clockwise direction in FIGURE 11 by a tension spring 155, one end of which is fixed to one end of the control lever 151 and the other end of which is fixed on a spring perch bracket 156 suitably secured to the post 25. The end of the control lever 151, opposite the end to which the wire 144 is connected, is adapted to engage the head 133 of the valve stem 132.

Thus, the air valve 131 may be opened so that suction currents are created at the nozzle 120 when a lug 140 on the main pattern chain 105 engages the lever 141 to thus rotate the collar 142 in FIGURE 10 and pull on the wire 144. Pulling on the wire 144 will rotate the control lever 151 in a counter-clockwise direction in FIGURE 11 to raise the valve stem 132 and open the valve 131.

The air valve 131 may also be opened by an adjustable abutment 160 (FIGURE 14) engageable with the head 133 of the valve stem 132 and threadably mounted in the outer free end of a second valve control lever 161. The inner end of the control lever 161 is formed integral with one end of a valve control shaft 162 oscillatably mounted adjacent opposite ends in respective bearing members 163 and 164 (FIGURES 11 and 12). The bearing member 163 is suitably secured on the upper surface of the support member 80 and the bearing member 164 is suitably secured to the upper end of the support member 86. The control shaft 162 has a first collar 166 fixed thereon and to which one end of a control link 167 is connected and the opposite end of which is adapted to, at times, be raised by an abutment 170 on a cutter actuator thrust rod 171. The lower end of the cutter actuator thrust rod is adapted to ride on and at times be raised by cams, not shown, on the main pattern drum 51 and the upper end thereof is adapted to operate the cutter mechanism, to be presently described.

Thus, any time that the cutter actuator thrust rod 171 is raised by cams on the main pattern drum 51, the control link 167 will be raised to thus rotate the control shaft 162 and move the second valve control lever 161 in a clockwise direction in FIGURE 14. The control lever 161 will thus depress the valve stem 132 and open the valve 131 to provide suction currents at the open flared end 122 of the suction nozzle 120.

Operation of the valve 131 may also be affected by the auxiliary pattern drum 82 through a second collar 173 fixed on the control shaft 162 and to which one end of a control arm 174 is suitably connected and the other end of which is engaged by the upper end of an adjustable abutment in the form of a screw 175. The lower end of the screw 175 is threadably embedded in the upper end of an auxiliary control arm 176. The upper end of the arm 176 is oscillatably mounted on the shaft 83 and its lower end has a finger or reading end 177 adapted to at times engage the outer periphery of the auxiliary pattern drum 82 and at other times to engage suitable cams 180 spaced around the periphery of the auxiliary pattern drum 82 and in vertical alinement with the reading end 177 of the arm 176.

Thus, operation of the air valve 131 is at times controlled by the auxiliary pattern drum 82 when movement of the pattern drum 82 causes one of the cams 180 to move the control arm 176 (FIGURE 13) in a counter-clockwise direction. The control shaft 162 will thus be rotated to raise the control arm 161 and valve stem 132 to open the air valve 131. Of course, when the arm 176 moves off of one of the cams 180 on the auxiliary pattern drum 82, the valve stem 132 of the valve 131 will be lowered to again close the valve 131 and cut off the suction in the nozzle 120.

The cutter actuator thrust rod 171 controls operation of the improved yarn cutter by its upper end (FIGURE 4) engaging the rear end of a lever 183 which is oscillatably mounted intermediate its ends as at 184 on the latch ring 40. The front end of the lever 183 has the upper end of a link 185 suitably connected thereto as at 186 and the lower end of the link 185 is suitably connected to the outer free end of a lever 190. The other end of the lever 190 is fixed on one end of a shaft 191 oscillatably mounted in a bearing block 192. The bearing block 192 is suitably secured to the upper surface of the dial cap 63 by a screw 193 and a locating pin 194 fixed in the lower surface of the bearing block 192 and adapted to engage a guide hole drilled in the upper surface of the dial cap 63. The end of the shaft 191, opposite the end to which the

lever 190 is connected, is bent downwardly to form a substantially vertical leg 196. The lower end of the vertical leg 196 penetrates one end of a control link 197 mounted for radial sliding movement in a milled slot 200 cut in the upper surface of the dial cap 63 (FIGURE 5). The link 197 is held in sliding engagement in the milled slot 200 by a cover plate 201 suitably secured in a second recess 202 milled in the upper surface of the dial cap 63.

The milled slot 200 is provided with an elongated hole 204 which is penetrated by a control pin 205, the upper end of which is fixed in the outer end of the link 197 and the lower end of which is adapted to pass through the dial cover 63 and operate the movable cutter blade, to be presently described. The outer periphery of the dial cam ring 62 is milled at an angle as at 207 and has respective upper and lower fixed cutter blades 210 and 211 fixed therein as by screws 212 which penetrate the upper blade 210 and the lower blade 211 and are threadably embedded in the dial cam ring 62. The upper fixed blade 210 and lower fixed blade 211 each has respective vertically alined elongated slots 214 and 215 therein for reception of the lower end of the control pin 205.

A movable curved cutter blade 216 having a body portion 217 is slidably mounted between the fixed upper blade 210 and the fixed lower blade 211 and the body portion 217 has an opening 218 therein adapted to receive the lower end of the control pin 205. When the thrust rod 171 is moved upwardly by a cam on the main pattern drum 51, it will rock the lever 183 in a clockwise direction, in FIGURE 4, to move the outer end of the link 190 downwardly and move the vertical portion 196 of the shaft 191 outwardly radially from the center of the dial cap 63. Outward radial movement of the vertical portion 196 of the shaft 191 will thus move the link 197 and slidable blade 216 outwardly to substantially the positions shown in FIGURES 6 and 7 or to yarn receiving position.

Upon the cutter actuator thrust rod 171 moving off of a cam on the main pattern drum 51, the lever 183 will be moved in a counter-clockwise direction, in FIGURE 4, to thus raise the link 185. The lever 183 is resiliently urged in a counter-clockwise direction upon the thrust rod 171 moving downwardly by resilient means to be presently described. With upward movement of the link 185, the movable blade 216 will be urged inwardly radially of the dial cap 83 to clip or cut the yarn closely adjacent the fabric shown at F in FIGURE 7 and leave a short tail or end, on the order of one-quarter of an inch, extending therefrom and to the fabric F. The movable blade 216 may be designed so as to cut the yarn at its bottom or mating edge with the fixed plate 211 and clamp the yarn between its upper edge which mates with the fixed blade 210, if desired, to thus act as a clamp and cutter.

The thrust rod 171 may also be raised by cams 219 (FIGURE 13) on the auxiliary pattern drum 82 which are in vertical alinement with an auxiliary control arm 219*a* oscillatably mounted on the shaft 83. The control arm 219*a* has one end of an arm 219*b* fixed thereto and the free end of which engages a notch 219*c* cut in the rear surface of the thrust rod 171. Thus cams, not shown, on the main pattern drum 51 as well as the cams 219 on the pattern drum 82 may operate the movable cutter blade 216 independently of each other.

In order to properly guide the yarns into the movable knife blade 216, as it is moved to its outermost position, and to also prevent any needles 35 from moving into the arcuate movable blade 216, a yarn guide plate 220 (FIGURES 3, 7 and 8) is provided which is suitably secured to the upper surface of the dial cap 63 by any suitable means such as screws 221. The yarn guide 220 is provided with a free arcuate end which extends partially around the dial cap 63 to overlie the movable cutter blade 216 and guide any yarn moved along the upper surface of the dial cap 63 into position for the movable blade 16 to cut the same.

It has been found advantageous to provide an excess of yarn between the yarn feeding fingers and the movable cutter blade 216 when the blade 216 is actuated so that more yarn will be available to be sucked up into the suction nozzle 120. This is accomplished by a slackening mechanism including a cam surface or detent 225 on the lower edge of the lever 183 (FIGURE 4). The detent 225 engages an outwardly extending arm 226 on a collar 227 oscillatably mounted on a stub shaft 230. The inner end of the shaft 230 is fixed in the dial drive gear bracket 55 and the outer end thereof has a collar 231 fixed thereto (FIGURES 4 and 6). A torsion spring 232 surrounds the post 230 and one end thereof is embedded in the collar 231 and the opposite end thereof is embedded in the collar 227. Thus, the torsion spring 232 normally resiliently urges the lug 226 into engagement with the detent 225 on the lever 183 and also normally urges the front end of the lever 183 upwardly in FIGURE 4.

The lower surface of the collar 227 has the upper end of a link 235 fixed thereto the lower end of which has one end of a connecting link 236 suitably secured thereto. The opposite end of the link 236 (FIGURES 3 and 4) is suitably connected to a quadrant plate 240 fixed to the upper surface of a sleeve or tubular member 241. The tubular member 241 is oscillatably mounted on a post 242 (FIGURE 3), the lower end of which is suitably embedded in the dial cap 63. A yarn guide wire 245 is suitably connected at its upper end to the lower surface of the plate 240 and extends outwardly and then downwardly at an angle to where its free end terminates in close proximity to the upper surface of the dial cap 63.

A yarn guiding or hold-down plate 246 is suitably secured at one end to the lower surface of the dial cam bracket 68 and extends outwardly therefrom, then upwardly and away from the bracket 68 to engage the yarns extending from the ends of the yarn feeding fingers 45 through 48 and prevents the yarns from raising above the level of the plate 240. Another yarn guiding member in the form of a wire 250 is suitably secured at one end to the boss 64 of the dial cap 63 (FIGURES 3 and 4) and extends at an angle upwardly therefrom to guide the yarns beneath the open flared mouth 122 of the suction nozzle as they pass over the dial cap 63.

A yarn guiding wire 252 is also provided (FIGURES 2, 3 and 4) for raising any yarns which are passed over the dial cap 63 so that the yarns may be more easily lifted by the suction currents at the suction nozzle 120. One end of the wire 252 is suitably secured to the boss 64 of the dial plate 63 and the other end thereof is bent downwardly into a milled slot cut-out 253 in the dial cap 63 in which the conventional yarn cutter is usually mounted.

Method of Operation

As is well known, particularly in knitting fine gauge ladies' full length stockings, it is customary to change yarns at several points during the knitting of the stocking, such as upon completion of the turned welt and after-welt. The welt and after-weft are usually knit of a relatively heavy denier yarn and a yarn change is made upon starting the leg portion of the stocking, which is usually knit of a light denier yarn. The yarn is again ordinarily changed at the beginning of the heel pocket in order to knit the heel pocket of the heavy denier yarn and again upon completion of the heel pocket in order to knit the foot portion of the light denier yarn. The yarn is ordinarily changed again before starting the toe pocket to knit the toe pocket of heavy denier yarn and again after completing the toe pocket to form the loopers rounds of a relatively inexpensive yarn. There may be other instances where it is desirable to change yarns, such as the knitting of a "red line" in the welt to identify the stockings during other operations.

The usual practice when changing from knitting with one yarn to knitting with another yarn is to move the yarn feeding finger carrying the new yarn to be knit into action a few needles before removing the yarn feeding finger carrying the previously knit yarn. By this

method, both the ingoing and outgoing yarns are used to form stitches for a few needles, usually approximately eight needles and thus, the leading end of the ingoing yarn is tied into the fabric before forming stitches from it alone.

When yarns are introduced and removed using the conventional spring clamp and cutting mechanism mounted on top of the dial, a substantially long end is left on both the ingoing and outgoing yarns which extend inside of the fabric approximately two inches. These long tails then have to be cut off in a subsequent operation so that they do not appear in the finished product and there is also danger of these long ends of yarn being picked up and again knit to form double stitches at subsequent courses. Also, since the single conventional spring clamping mechanism holds a plurality of yarn ends, one from each of the yarn feeding fingers, when one of the yarn ends is pulled from the clamp other yarn ends are also pulled beneath the spring clamp.

The present invention will be described when used at one typical yarn change position, it being understood that the present invention is used with each yarn change throughout the knitting of the stocking, when the yarn is first introduced to the needles at the start of a stocking, and at the completion of the stocking when the yarn is removed from feeding position.

Ordinarily, ladies' seamless stockings are knit from the top to the toe with the turned welt and after-welt or shadow welt being knit of a relatively heavy denier nylon yarn on the order of 40 denier. Assuming that this type yarn, indicated at Y–1, is fed through the yarn feeding finger 45 (FIGURE 3) and all of the cylinder needles 35 are drawing stitches therewith while the inoperative yarn feeding fingers 46 through 48 have respective yarns Y–2, Y–3 and Y–4 threaded therethrough and each of which extends beneath the yarn plate 246, wire 245, wire 250, and then upwardly so that their free ends are disposed a substantial distance inside of the suction nozzle 120.

When the welt of the stocking has been knit with the heavy denier yarn Y–1, and it is desired to knit the leg portion with a light weight nylon yarn such as 15 denier, indicated at Y–2, the yarn feeding finger 46 will be lowered to operative position by a conventional thrust rod controlled by the main pattern drum 51 so that both the yarns Y–1 and Y–2 are fed to approximately eight needles to form double yarn stitches therewith from both of these yarns. The leading end of the yarn Y–2 will be held by the suction nozzle 120 and will extend from the suction nozzle 120, over the dial cap 63 and to the first cylinder needle which took this yarn. The suction having been applied to the suction nozzle 120 a short time before the yarn finger 46 was moved into feeding position by a cam 180 on the auxiliary pattern drum 82 engaging and moving the control arm 176 to open the air valve 131 and provide suction at the nozzle 120.

As the cylinder needle which first receives the leading end of the yarn Y–2 continues to move in a counterclockwise direction, the suction nozzle 120 will continue to hold this end in a tensioned position. After eight needles have taken both yarns, the yarn feeding finger 45 feeding the yarn Y–1 is moved to inoperative position by a conventional thrust rod and movement of the main pattern drum 51 or to substantially the position shown in FIGURE 6 so that the trailing end of the yarn Y–1 extends from the last needle which knit up to the yarn feeding finger 45.

As the needles carrying the leading end of the yarn Y–2 and the trailing end of the yarn Y–1 approach the movable cutter blade 216, the cutter blade 216 is moved to the open position shown in FIGURES 6 and 7 by upward movement of the cutter actuator thrust rod 171 and through the linkage heretofore described. At the same time that the lever 183 is moved downwardly to open the movable cutter blade 216, the detent 225 thereon moves the collar 227 to move the lower end of the link 235 away from the observer in FIGURE 4 and to switch the plate 240 from substantially the position shown in FIGURE 3 to the position shown in FIGURE 6 and pull an additional amount of yarn Y–1 through the yarn feeding finger 45. The additional yarn is shown in FIGURE 6 surrounding the wire 245, passing beneath the plate 246, against the sleeve member 241, beneath the wire 250, over the wire 252, beneath the suction nozzle 120 and to the cylinder needle where the yarn Y–1 was removed.

As the needle carrying the leading end of the yarn Y–2 and the needle carrying the trailing end of the yarn Y–1 pass between the arcuate movable blade 216 and the fixed blades 210 and 211, the thrust rod 171 is moved downwardly so that the blade 216 will move inwardly and cut the leading end of the yarn Y–2 and the trailing end of the yarn Y–1 so that only short ends remain on each yarn from the lower surface of the cutting blade 216 to the fabric F (FIGURE 7) on the order of one-quarter of an inch.

At the same time that the cutter blade 216 is moved inwardly, the plate 240 and wire 245 are swung from the position shown in FIGURE 6 to the position shown in FIGURE 3 and the cut end of the yarn Y–2 is sucked up into the suction nozzle 120 to pass through the tube 125 and be deposited in the bag 126 and the cut end of the yarn Y–1 from the cutter blade is sucked up into the air nozzle 120 to be held thereby until it is desired to again feed this yarn.

Since the suction in the nozzle 120 may be controlled by the lugs 140 on the main pattern chain 105, cams on the main pattern drum 51 and cams on the auxiliary pattern drum 82, it is evident that the amount of time that the suction nozzle is operative may be varied independently of operation of the cutter actuator thrust rod 171 and actuation of the movable cutter blade 216. Also, since the cutter actuator thrust rod 171 may be operated from either the cams on the main pattern drum 51 or the cams 219 on the striper drum 82, the cutter blade 216 may be operated at any time during the knitting of the stocking and in quick succession when desired. For instance, when it is desired to feed a yarn, such as the yarn Y–3, for only two courses to form a "red line" in the stocking the yarn can be changed rapidly and still cut the ends short by operating the cutter blade 216 by cams on the auxiliary pattern drum 82 which, as is well known, may be moved more rapidly than the main pattern drum 51.

It is thus seen that there has been provided a yarn clamping or holding means for knitting machines which utilizes reduced air pressure or suction to hold the ends of the yarns introduced and removed from feeding position until cut by an improved cutting mechanism. The improved cutting mechanism includes an arcuate movable cutter blade mounted closely adjacent the circle of cylinder needles to cut both the leading and trailing ends of yarns introduced and removed from knitting position in relatively close proximity to the point at which the yarns are introduced to and removed from the fabric. The suction yarn holding means also removes the short piece of yarn extending from the cutter blade to the suction means and at the leading end of the yarn introduced to the fabric.

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 claim.

We claim:

In a circular knitting machine having circularly arranged cylinder needles and a plurality of yarn feeding fingers movable into and out of yarn feeding position relative to said needles, a pattern chain, a main pattern drum and an auxiliary pattern drum; the combination

therewith of a single yarn cutting device disposed closely adjacent the path of said cylinder needles, said cutting device comprising a fixed cutting blade and a movable cutting blade, pattern controlled means for moving said movable cutting blade in timed relation to movement of said yarn feeding fingers, an open ended nozzle adjacent said cutting device, means for creating suction currents adjacent said open ended nozzle to attract the ends of all yarns severed by said cutting device into said nozzle, and control means for selectively activating said suction creating means from said pattern chain, said main pattern drum or said auxiliary pattern drum.

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