Feb. 6, 1940. H. AGULNEK ET AL 2,189,276

METHOD AND APPARATUS FOR PRODUCING STRIPED KNITTED FABRIC

Filed June 9, 1938 4 Sheets-Sheet 1

Fig. 1.

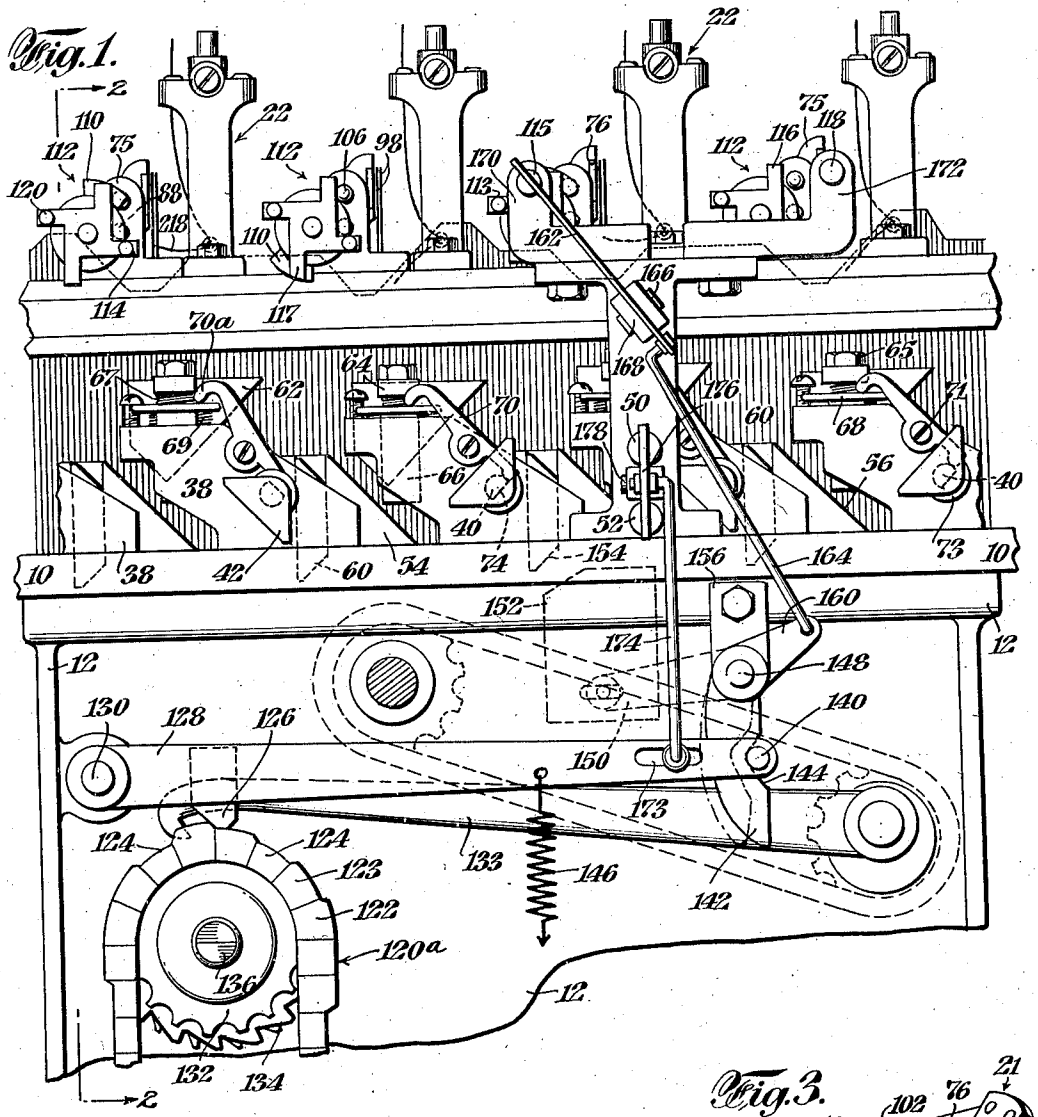


Fig. 4.

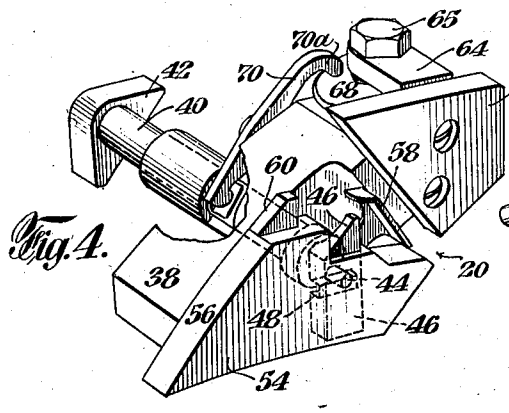
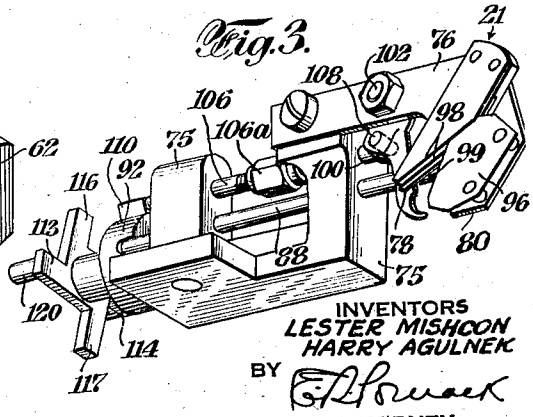


Fig. 3.



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METHOD AND APPARATUS FOR PRODUCING STRIPED KNITTED FABRIC

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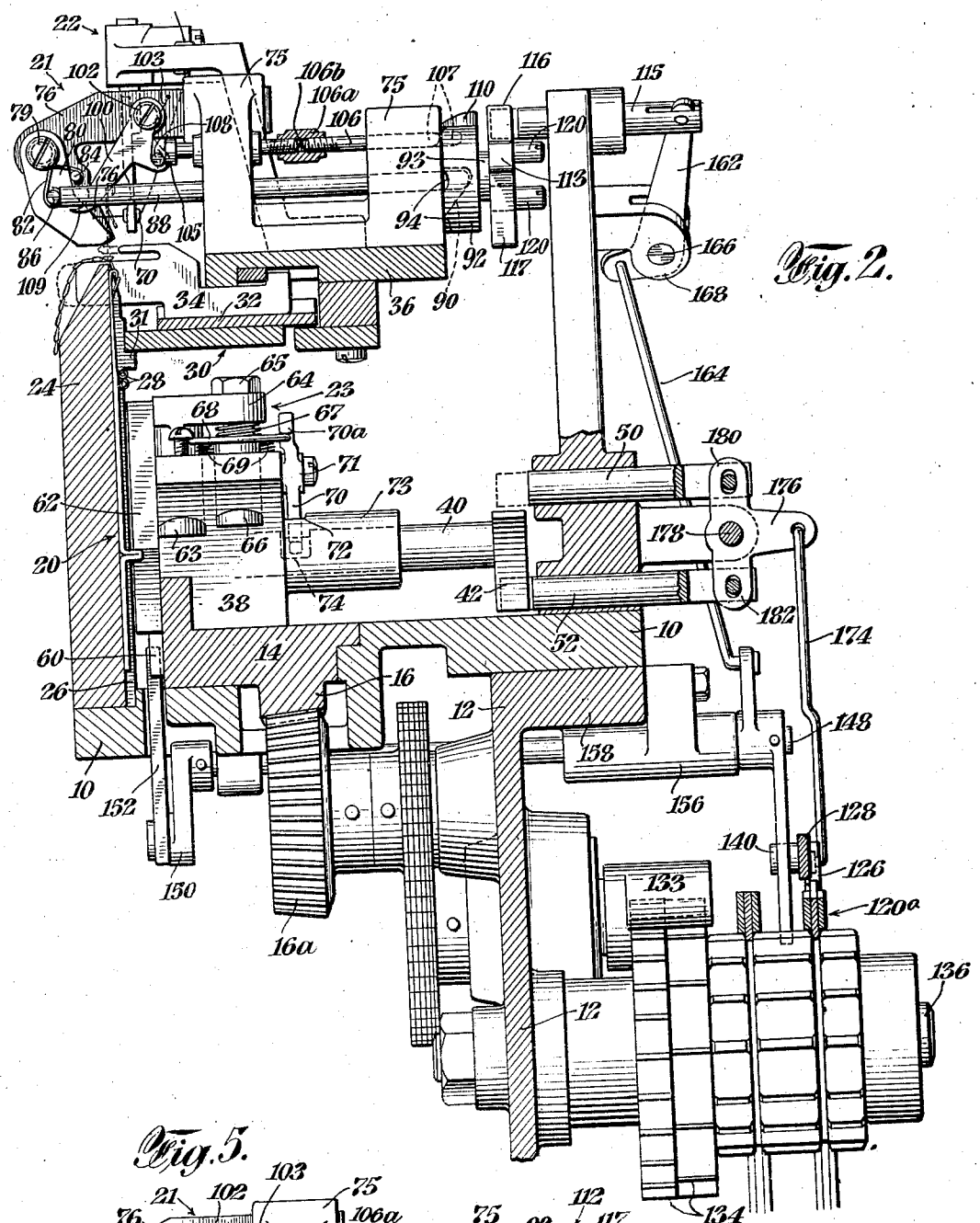

Fig. 2.

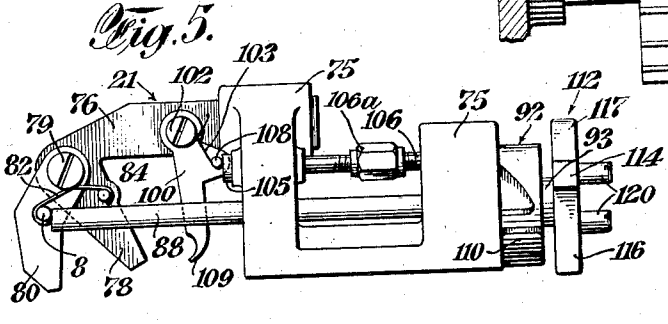

Fig. 5.

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METHOD AND APPARATUS FOR PRODUCING STRIPED KNITTED FABRIC

Filed June 9, 1938 4 Sheets-Sheet 3

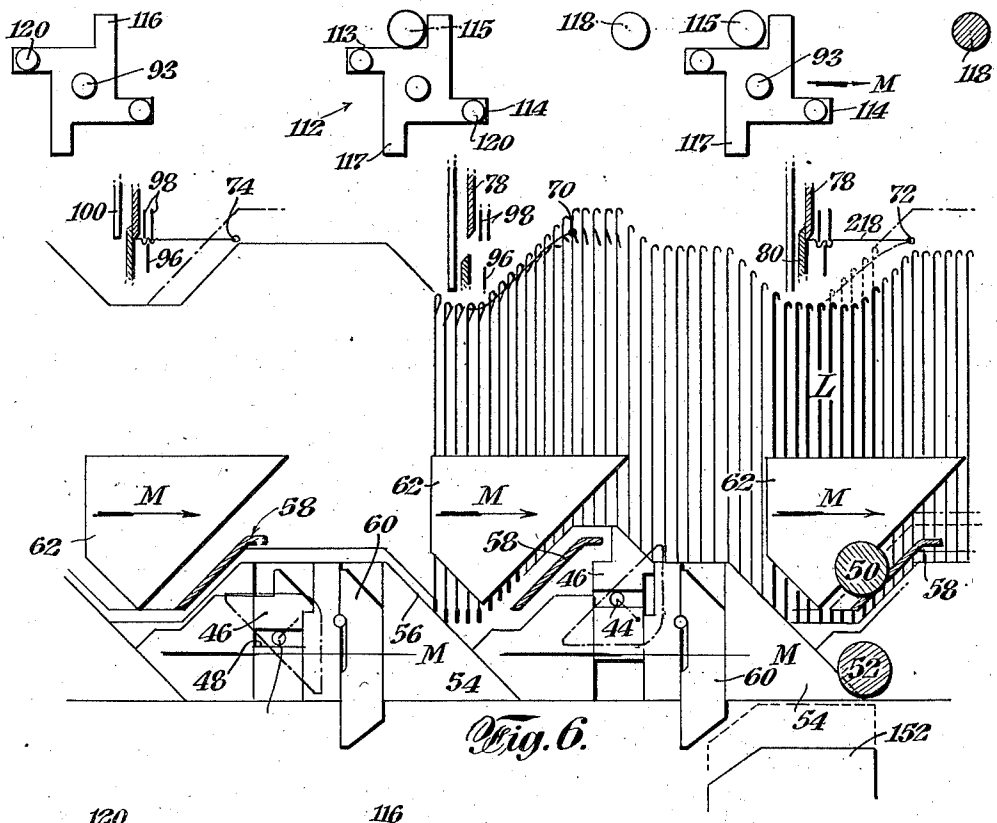

Fig. 6.

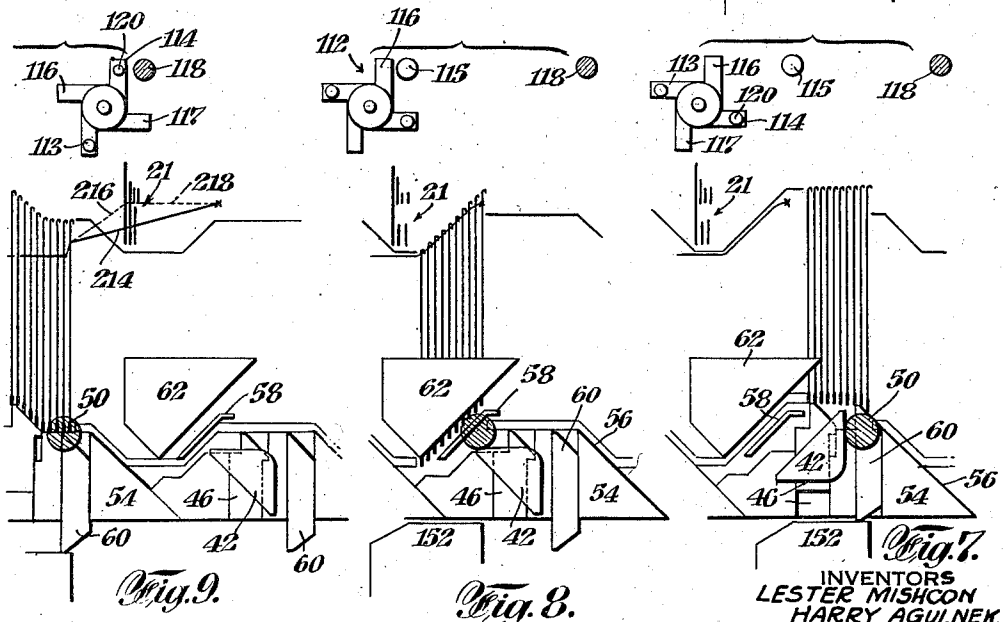

Fig. 9.

Fig. 8.

Fig. 7.

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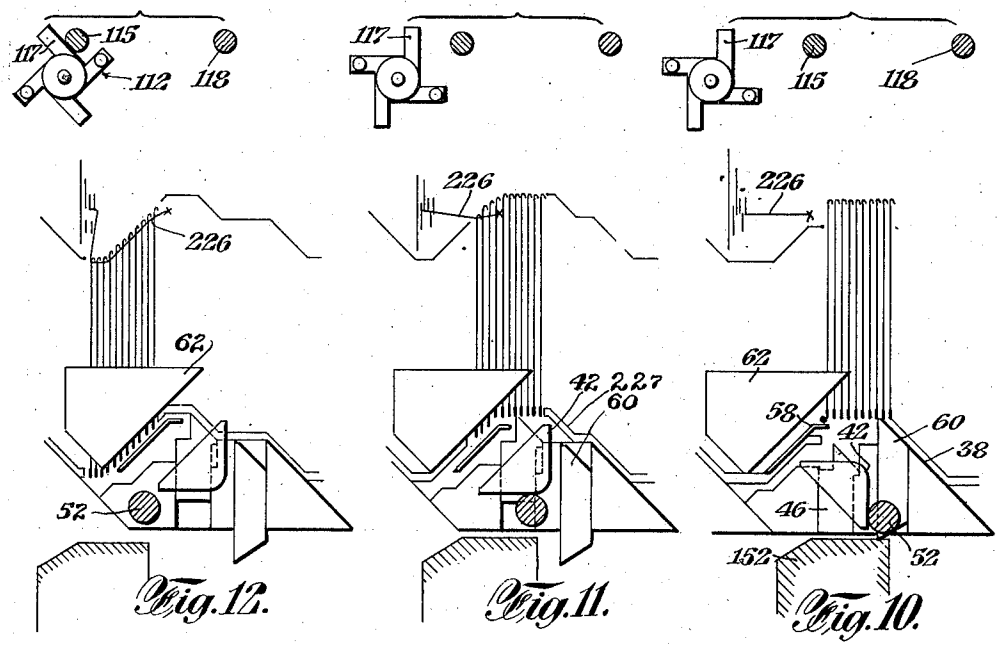

Fig. 12. Fig. 11. Fig. 10.

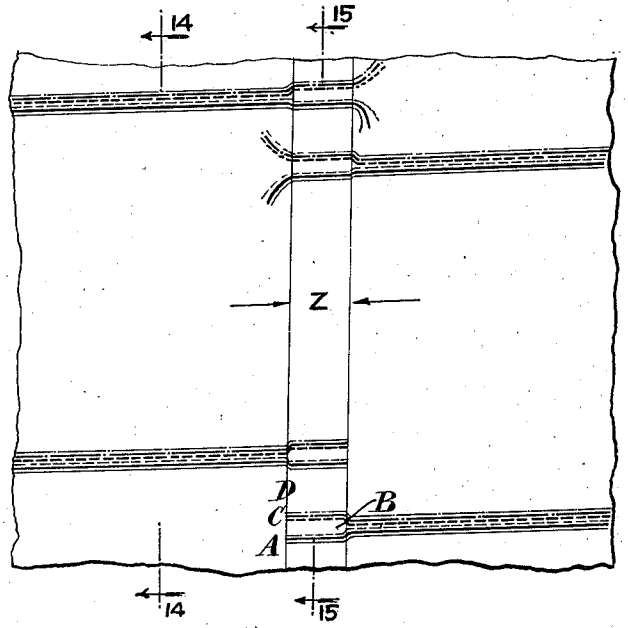

Fig. 13.

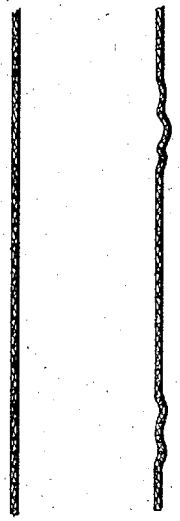

Fig. 14.

Fig. 15.

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Patented Feb. 6, 1940

2,189,276

UNITED STATES PATENT OFFICE

2,189,276

METHOD AND APPARATUS FOR PRODUCING STRIPED KNITTED FABRIC

Harry Agulnek and Lester Mishcon, Brooklyn, N. Y., assignors to Samuel Mishcon, doing business as Supreme Knitting Machine Co., Brooklyn, N. Y.

Application June 9, 1938, Serial No. 212,670

13 Claims. (Cl. 66—42)

This invention relates to improvements in circular knitting machines adapted for the production of striped fabrics.

It is primarily within the contemplation of our invention to enable circular knitting machines, particularly of the open top independent latch needle variety, to fabricate at a high rate of production a wide variety of striped materials, and to enable tubular fabric to be knitted with a well-defined, closed seam formed by overlapping courses.

The most commonly employed means for effecting the production of striped knitted fabric has heretofore been what is commonly referred to as the four finger striping box which, by its very nature, has certain inherent shortcomings including limited selectivity and productive capacity; and besides, the fabric produced by such machines contain a relatively tight, hard and inflexible seam frequently found disadvantageous in processing and other operations to which the finished fabric is subjected. The limited productivity is due to the fact that only one color of each box could be knitted in at a time, so that the maximum number of courses per revolution of the knitting machine must of necessity be limited to the number of boxes, which seldom exceeds eight; and the above-referred-to unsatisfactory seam results from the fact that during the transition or color change-over period, both the incoming and outgoing yarns are simultaneously fed and looped together over each of the needles, thereby producing a relatively hard inflexible longitudinal seam therein.

It is hence among the objectives of our invention to overcome these difficulties by not only enabling striped material to be produced with a well-defined closed seam, but also to enable a multi-feed machine, such as the conventional thirty-two feed machine, to produce for each revolution of the machine a spiral of thirty-two courses including both background or body yarn and stripes.

In that aspect of our invention directed towards increased productivity, the mechanical embodiment thereof can produce in a thirty-two feed machine as many as thirty-one feeds at one time plus a colored stripe on the thirty-second feed; or it may produce wider stripes of many courses and narrower body portions, all the thirty-two feeds working towards fabric output while the stripe is being knit, whereas the number of feeds working when producing background for the body portion of the fabric is thirty-two minus the number of colored yarn feeds.

It is a further object of our invention to enable a machine of this nature to operatively employ any number of the feeds thereon, putting them in and out of operative engagement in accordance with a predetermined set-up of control means, all in a manner to be hereinafter set forth.

In that aspect of our invention directed towards the production of a well-defined overlapping seam, it is within our contemplation to enable all the needles on the cylinder to be operatively employed during the striping operation, a result which we obtain by operatively actuating an auxiliary tucker cam at predetermined times both prior and subsequent to the engagement and disengagement of a feed, thereby causing the overlapping structure of the stripe and substantially closed seam. The said auxiliary tucker, in accordance with our invention, is coactively engageable with a predetermined number of adjacent special needles at that region of the machine where the engagement and disengagement of the various yarns are effected, these special needles containing, in the preferred form of our invention, relatively long butts. The arrangement is such as to obviate the expedient frequently employed of removing certain needles in the change-over region for avoiding a trail or wake of butts during this operation, which tend to create an irregular seam, and in this manner we eliminate the unwanted gaps and weakened areas frequently found at the seams of striped knitted fabrics.

In most conventional knitting machines provided with striping mechanism, there is always an accumulation of waste yarns that are wound around the central post of the machine during the striping operation, it being necessary to periodically remove such accumulations when the center post region becomes unduly congested. It is hence another object of our invention to enable striping to be done without any undesirable accumulation or congestion of the yarn employed in the knitting operation.

Among other objects of our invention are the manufacture of wide striped tubular knitting fabric, and the production of striped knit goods having a longitudinal seam area of predetermined width and circumferential position.

To aid in the accomplishment of the aforementioned objects, it is within the further contemplation of this invention to provide means for automatically bringing the yarn about to be disengaged into such a predetermined position as to enable it to be properly cut and held clamped

in position until again knitted, all in proper timed knitting relationship with the needles.

And still another object of this invention is to provide tension relief mechanism adapted to be operatively actuated in timed relation with the tucking mechanism for the purpose of taking unwanted strains off the stitches.

Other objects, features and advantages will appear from the drawings and the description hereinafter given.

Referring to the drawings:

Figure 1 is a front view of a fragment of a multi-feed circular knitting machine embodying our invention.

Figure 2 is a sectional view taken substantially along line 2—2 of Figure 1.

Figure 3 is a perspective view of a pick, cut and clamp section employed in our invention and illustrated in Figures 1 and 2.

Figure 4 is a perspective view of a cam section forming part of the knitting machine containing our invention, showing both the main and auxiliary tuckers.

Figure 5 is a side elevation of the pick, cut and clamp section of Figure 3.

Figure 6 is a diagrammatic view of a plurality of feed sections in different relative positions with respect to the cylinder.

Figures 7, 8 and 9 are diagrammatic views illustrating a sequence of events of one of the feed sections of Figure 6 in effecting a discontinuance or disengagement of a feed.

Figures 10, 11 and 12 are views similar to Figures 7, 8 and 9 but illustrating a sequence of events for bringing a yarn into operative engagement with the feed.

Figure 13 is a diagrammatic view of an exemplary fragment of a striped tubular knitted fabric producible by the machine illustrated in the other figures, including a longitudinal seam, and

Figures 14 and 15 are sections of the fabric of Figure 13 taken substantially along lines 14—14 and 15—15 respectively.

In the drawings, and particularly Figures 1 and 2 thereof, the conventional portions of the structure illustrated include a stationary supporting ring 10 carried by supports 12 upon which are suitably mounted conventional driving mechanism including the bevel gear 16a in operative engagement with gear 16 forming part of a suitably mounted rotatable cam ring 14. The stationary support 10 carries the needle cylinder 24 containing the conventional latch needles operatively movable within grooves 26 on the outer surface thereof, said cylinder being provided with a rim shoulder 31 in supporting engagement with the sinker assembly supporting means 30 upon which is supported the sinker support ring 32 provided with radial grooves within which are operatively positioned the sinkers 34. The butts of said sinkers are in operative engagement with the sinker cam ring 36 in conventional manner. The rotatable ring 14 and sinker cam ring 36 share in the support of certain other units which are adapted to rotatably move about the cylinder to operatively actuate and engage the needles, yarn and certain stationary timing mechanisms, all in a manner to be hereinafter set forth, such units including the composite cam assembly units 20, the pick, cut and clamp units 21, the tension relief mechanisms 23 and the yarn carriers 22. It will be observed that each of the said pick, cut and clamp units and yarn carrier units are disposed slightly to one side (to the left in the drawings) of their sectionally related cam units 20, in the preferred form illustrated.

Referring to the said cam units 20, each of said units includes a cam block 38 providing a journal for the rotatable shaft 40 containing at its outer end the rocker foot 42 and at its inner end the eccentric crank pin 44. By referring particularly to Figures 4 and 6, it will be seen that the said crank pin 44 extends into the horizontally disposed slot 48 within the main tucker 46 whereby upon a rotary manipulation of the shaft 40 the said main tucker 46 can be slidably actuated within the vertical slot contained within the outer surface of the cam 54. The said rocker foot 42 is adapted, by suitable actuating means, to be alternately rotated to positions 90° apart, whereby the said main tucker 46 will be correspondingly raised or lowered at the extremities of the oscillatory positions of the rocker foot. Although the means for effecting a selective actuation of the rocker foot 42 will be described in a later portion of this specification, it should nevertheless be at this time noted that the proximate elements that are adapted for actual engagement with the rocker foot are the trip pins 50 and 52 supported by a stationary mounting and adapted to be alternately projected into the path swept by said rocker foot during its rotatable movement about the cylinder.

The said cam unit 20 also contains the raising cam segment 54 which contains the butt-engaging rising surface 56, said segment also supporting a separating cam 58, preferably of the type illustrated in Patent No. 2,006,821 in which the cam is yieldably retractible outwardly; said segment also containing a vertical recess for accommodating the auxiliary tucker 60 in addition to the main tucker 46 as aforesaid. It should be noted that the said main tucker 46 is disposed inwardly close to the needle cylinder to effectively cooperate with needles having either long or short butts, whereas the said auxiliary tucker 60 is disposed radially outwardly or farther away from the cylinder than the said main tucker, so that it will be operatively engageable only with needles having long butts.

Each of the said cam units 20 also has mounted thereon a vertically movable stitch cam 62, said cam (see Figures 2 and 4) being affixed to the post 63 slidably mounted within the cam block 38, the upper portion of said post being provided with a horizontal connecting bar 64 through which extends the bolt 65, the lower portion 66 of which is also slidably movable within a suitable aperture within the block 38. A spring 67 is mounted over an upper reduced portion of the shank of said bolt and is positioned between and in abutting engagement with said horizontal bar 64 and a plate 68 rigidly affixed to said shank. Supported by the block 38 are the springs 69 which are in engagement with the underside of said plate 68, normally urging it upwardly against the action of spring 67, thereby consequently forcing upwardly the said bar 64 and post 63 together with the stitch cam 62. A lever 70 is pivotally mounted at 71 to the block 38, one terminal 70a of the lever being in constant engagement with the upper surface of said plate 68 (through the actions of said springs 69), and the other terminal being consequently held in engagement, through an aperture 72 in the journal 73, with the shaft 40, said shaft containing a depressed portion 74 adapted to be in registry with said aperture once during every revolution of the shaft 40.

When the said rocker foot 42 is operatively rotated by the trip pins 50 and 52, in a manner to be specifically hereinafter described, the lower terminal of the lever 70 will be in a lowered position when it is in engagement with said depression 74 and in an elevated position when in engagement with the other portions of the shaft 40, thereby producing a corresponding raising or lowering of the opposite terminal 70a of the lever 70. When the said terminal 70a of the lever is lowered by such action, it will depress the plate 68 together with the associated parts to cause a lowering of the stitch cam 62, and when said terminal 70a is raised, the said springs 69 will cause an elevation of the stitch cam as aforesaid. It is hence apparent that at certain predetermined times with respect to the rotation of shaft 40, the stitch cam 62 can be either raised or lowered, in accordance with the predetermined setting of the machine. The parts are so designed that when the main tucker 46 is in its raised position, the stitching cam is in its lowered position, and when the main tucker is in its lowered position and the needles in said feed not knitting, the said stitch cam 62 is in its elevated position. This is of course made possible by positioning the recessed portion 74 in shaft 40 at a suitable predetermined position thereon. It is hence obvious that when the needles in the region of a feed are not knitting, the stitch cam is kept out of any possible engagement with the butts to prevent an unnecessary tension on the stitches at such times.

As is necessary in machines for producing a striped fabric, provision must be made at a certain point during the rotary operation of the machine for engaging a new yarn of one color and disengaging another yarn when that color is no longer needed. The yarn-engaging mechanism generally consists of an arrangement of cams for elevating certain selected needles at a certain region so that they will be in a position to take the desired yarn extending from the eyelet of a yarn feed, certain other cams thereafter drawing these needles downwardly to effect the knitting operations. The yarn disengaging mechanism requires that at a predetermined point the yarn which is to be discontinued be cut and held in position ready for re-engagement at some subsequent time. In the physical embodiment of our invention we not only effect a cutting and clamping for the purposes above stated, but also enable such operations to be very conveniently and efficiently performed by providing in a single unit an arrangement of parts which first picks up the yarn to be cut and positions it within the throat of the cutting mechanism in a substantially horizontal position, so that a positive operation can be obtained at all times, the device being particularly compact in form so as to enable a multiplicity of such units to be employed on a multi-feed machine.

Specifically, each of the pick, cut and clamp units identified by the reference numeral 21 comprises a supporting structure 75 having mounted thereon a plate 76 provided preferably at its inner end with a stationary blade 78, and a movable blade 80, pivotally mounted at 79, adapted for cooperation with such stationary blade as a shearing mechanism. The said movable blade 80 is normally urged by the spring 82 into closed position against the stop pin 84 extending outwardly from the stationary blade 76, one end of the spring 82 being anchored to a stationary element such as the pin 84, and the other end to another pin 86 extending outwardly from the movable blade 80, said latter pin being held in constant engagement with the terminal of the operating rod 88 slidably supported within the bracket 75. The outer terminal of said rod 88 is adapted to engage and follow a depression cam 90 forming part of a drum or cylindrical member 92 mounted upon a shaft rotatably supported by the bracket 75. The said cylindrical member also contains preferably three notches 94 with which the said outer terminal of rod 88 is also engageable by the action of spring 82, so that the said cylindrical member is adapted to be retained in quadrangular positions for every revolution thereof, the rotational movement of said cylindrical member being effectuated in a manner to be hereinafter described.

It is obvious that when the outer terminal of rod 88 enters the depression within cam 90, it will be retracted outwardly to permit the spring 82 to operatively actuate the movable blade member 80 to effect a yarn cutting operation. It is also apparent that upon a continued operative rotation of the said cylindrical member 92, the bar 88 will be projected inwardly against the pin 86 to cause an opening of the movable blade 80. According to the preferred manner of operating this device, four impulses are imparted to the cylindrical member 92 at predetermined times, thereby holding said member in three inoperative positions, and in one operative position when the rod 88 is in operative engagement with said depression cam 90.

The clamping mechanism consists of a movable clamp blade 96 attached to the movable cutting blade 80 and in spaced relation with respect thereto, this blade being adapted to enter between the two spaced flexible blades 98 affixed to the stationary cutting blade 78 (see Figure 3). This will enable a yarn extending across the jaw 99 between the said blades when in their open positions to be engaged by the clamp blade 96 and drawn into the space between the said flexible blades 98, to be retained there until released by a new projection of the operating rod 88, as aforesaid.

The unit 21 is also provided with a picker arm 100 which is adapted to engage a selected yarn and elevate it into a substantially horizontal position between the said blades and into the cutting zone. In this manner not only will the yarn be so positioned that it can be conveniently cut in a positive manner, but also be properly retained in a horizontal position, extending from the yarn eyelet to the cutting and clamping mechanism, as indicated by the broken lines in Figure 9, and also by the full line in Figure 10. Before proceeding to consider the specific operating mechanism of said picker arm, it should be noted in this connection that the said cutting and clamping zone of the device is preferably substantially at the level of the feeding eyelet.

In the form of unit 21 illustrated, the said picker arm 100 is, in its inoperative position, substantially vertically disposed, being pivotally mounted at 102 and normally urged outwardly to its inoperative position by a spring 103 preferably anchored upon the plate 76. Protruding from the picker arm 100 is the pin 108 which is held by said spring 103 in constant engagement with the inner terminal head 105 of the slidable actuator rod 106 slidably mounted within the structure of frame 75. The outer terminal portion 107 of said actuator rod is engageable with a barrel cam segment 110 positioned on the periphery of the cylin-

drical member 92, whereby, upon a rotatable movement of said cylindrical member, the said segment is caused to move the actuator rod inwardly, consequently causing the head 105 engaging the pin 108, to rotatably actuate the picker arm 100 until the yarn engaging hook 109 thereof is brought into predetermined position with respect to the jaw of the blades. When this operative movement of the picker arm is effected, the said hook 109 will lift the yarn positioned thereabove into the proper position within the jaws of the cutting and clamping blades, in accordance with the above-stated requirements. In accordance with the illustrated design, the said actuator rod 106 is actuated slightly in advance of the rod 88 so as to bring the picker into its operative position just prior to the cutting operation. Both rods are held in their projected operative positions at this point until the cylindrical member 92 is again rotatably actuated, whereby they will be forced outwardly by the action of said springs 82 and 103.

It will be noted that the shaft 106 is of split construction with a nut or turnbuckle 106*a* operatively mounted over the threaded proximate end portions 106*b* of the two sections of this shaft. Upon a rotatable manipulation of said turnbuckle, the terminal head 105 can be moved to different predetermined positions, thereby bringing the hook 109 of the picker to different operative positions. In this manner the yarn engaged by the picker can be brought to different positions within the jaw of the blades, in accordance with the direction and degree of rotation of turnbuckle 106*a*. Hence if a cutting blade should become dulled due to the continued use of the yarn-engaging portion thereof, the position of the yarn could be slightly shifted to another portion of the blade, by a manipulation of the turnbuckle, thereby prolonging the effective life of the blade, and obviating frequent replacements.

The said cylindrical member 92 is attached to the shaft 93, the outer termination of which has secured thereto the cross member 112 consisting of two sets of oppositely disposed arms, the said arms 113 and 114 containing pins 120 thereon extending outwardly, and the arms 116 and 117 having no obstructions or extensions thereon. The said cross member 112, in traversing its circular path about the cylinder, is adapted to be operatively actuated by certain pins interposed in its path, the pin 115 being projectable radially inwardly to intercept, at predetermined times, the said arms 116 and 117, and the pin 118 being stationary and adapted at other times to operatively engage the pins 120, to effect rotational movements of the cross member 112 and the cylindrical member 92, to operatively actuate the pick, cut and clamp mechanism hereinbefore referred to, all in a manner to be more fully hereinafter described.

In the operation of this machine, it is essential that the auxiliary tucker 60 and the pick, cut and clamp unit 21 be always actuated at about the same time, inasmuch as the said auxiliary tucker, acting only on certain long butt needles, performs its intended function only in preparation of the yarn engaging and yarn disengaging operations; and the main tucker 46 is elevated only during the time its section is feeding and knitting. In carrying out the purposes of this invention we have found it exceedingly desirable to employ a single control mechanism for operatively actuating, at predetermined times, the said pick, cut and clamp unit 21, and the said main and auxiliary tuckers, which will now be described.

A timing chain 120*a* is synchronously geared to the rotatable portions of the knitting machine, said chain having thereon a plurality of links of various heights, preferably high, medium and low, these being identified in the drawings by the reference numerals 122, 123 and 124 respectively. The said chain is mounted upon a sprocket drum 132 intermittently actuated by a pawl mechanism 133 operatively connected by driving means more fully described in Patent No. 2,112,260 issued March 29, 1938, whereby the said chain 120*a* may be advanced step by step in accordance with a prearranged setting, as fully described in said patent.

An arm 128 is pivotally mounted at 130, said arm carrying a follower 126 adapted to successively engage the links on the said chain 120*a*, the spring 146 urging the follower into operative engagement with the links. The said arm (see Figure 1) is provided at its extreme right end with a pin 140 which is engageable with the cam lever 142 containing a depressed preferably V-shaped cam edge 144 the apical portion of which is adapted to engage said pin 140 when the medium link 123 is in engagement with the follower 126 as illustrated in the figure. Under this construction, it will be observed that upon either a raising or lowering of arm 128 from the position shown, the said cam 142 will be rotated in a clockwise position to the dot-dash position illustrated, it being hence evident that such an operative movement of the cam 142 can be effectuated when the follower 126 engages either a high link such as 122 or a low link such as 124.

The shaft 148, to which the same cam 142 is attached, has also affixed to the inner terminal thereof the arm 150 which is pivotally connected to the vertically movable auxiliary tucker trip 152. When the arm 150 is operatively actuated by the movement of cam 142, the said auxiliary tucker trip 152 is actuated upwardly into the swept path of the depending ends 154 of the auxiliary tuckers 60 as they are rotatably moved about the cylinder. Inasmuch as said depending ends of the auxiliary tuckers are bevelled, and the upper portion of the trip mechanism 152 is correspondingly bevelled, the operative engagement between the auxiliary tucker trip 152 and the auxiliary tuckers will cause an elevation of the latter, thereby placing them into condition to perform their operative function during the yarn change-over period. It should be noted that the said shaft 148 is suitably supported at its outer end in the bracket 156 which in turn depends from flange 158 of the standard 12.

The shaft 148 has also affixed to the outer end thereof an arm 160 connected to a bell crank 162 through the medium of the upwardly extending link 164. The bell crank is pivoted at 166 to a bracket 168 mounted on the said stationary supporting ring 10. Adjustably secured to this bracket are the blocks 170 and 172 these blocks supporting the pins 115 and 118 respectively.

It will be observed that with the said follower 126 in engagement with a medium size link 123, the pin 115 is outside of the swept path of the cross member 112, and the auxiliary tucker trip member 152 is inoperative (in a down position). It will also be apparent that upon an actuation of the arm 128 either up or down, by means of high or low links 122 or 124, the tucker trip

152 is raised and the pin 115 is projected inwardly, both simultaneously, due to the fact that the arms 150 and 160 are both simultaneously operated upon an operative movement of the cam 142.

The arm 128 has also pivotally attached to it, at the slot 173, the link 174 the upper terminal of which is pivotally connected to a compound bellcrank 176 rotatably mounted at 178 on the bracket 168, the upper and lower arms 180 and 182 of the bellcrank having slotted portions thereof within which the pins 50 and 52 are operably connected. When a high link 122 encounters the follower 126, the arm 128 will consequently be raised to produce a counterclockwise rotation of the bellcrank 176, thereby projecting the pin 50 inwardly; and when the follower encounters a low link 124, the arm 128 will be lowered (under the influence of spring 146) to cause a clockwise rotation of bellcrank 176, a retraction of pin 50 and an operative projection of pin 52; and when the follower encounters a medium link 123, the bar 128 will be in its neutral or inoperative position, and both of the pins 50 and 52 will consequently remain in inoperative and unprojected positions. When either of the pins 50 or 52 are operatively projected inwardly, they will intercept any oncoming rocker feet 42 to cause a tripping thereof and an operative rotation of shaft 40, whereby the main tucker 46 is either raised or lowered in the manner hereinbefore described. An operative projection of pin 50 will cause a lowering of said main tucker, whereas an operative projection of pin 52 will cause a raising thereof, for purposes which will appear from the description hereinafter given.

It thus appears, as aforesaid, that the links on the chain 120 control the operative movements of the pick, cut and clamp unit, the auxiliary tucker 60 and the main tucker 46 together with its associated parts. For operative conditions, the sequence of links must then be so arranged as to enable an idle feed section or yarn to be thrown in when desired, and to discontinue in proper relation thereto a previous working feed or yarn, the operations of certain of the associated parts being performed at about the same time to enable the change-over to be efficiently and expeditiously effectuated.

It will be convenient to refer to Figure 6 which shows two feed sections in operative relation to the needles about the cylinder, the central portion of the illustration showing the arrangement of the parts when a feed from eyelet 70 is being knitted, and the left portion of the illustration showing the relation of the parts when a yarn from eyelet 74 is to be cut and clamped and hence discontinued. For the purpose of this illustration, the long butt needles include those within the extent of the arrow L, these being, as aforesaid, engageable by both the main tuckers 46 and auxiliary tuckers 60, whereas all the other needles have short butts that do not extend to the region of the said auxiliary tucker 60 and are hence engageable only by the said main tucker 46. The rotation of the cam ring and associated parts is in the direction of the arrows designated by the letters M.

As the needles to the extreme right of the illustration of Figure 6 are successively brought into engagement with the oncoming tucker and cam members, they will assume positions clearly shown in the drawing, the long butt needles being shown in the welt position and subsequently rising to the tuck level, to further rise to the latch clearing level whereby they will be in a position to operatively take the yarn from eyelet 70, the needles then being drawn down by the stitch cam 62 to perform the knitting operation, the knife blades 78 and 80 and clamping blades 96 and 98 (diagrammatically illustrated) being shown in their open position, and the yarn from eyelet 70 being carried downwardly out of reach of the said blades. It will also be noted that in the said "feeding" position, the butts of the needles travel above the separating cam 58, and are entirely free from engagement therewith. At this step of the operation, the auxiliary cam 60 is shown in its lowered position whereas the main tucker 46 is shown in its raised position, so that it is operatively adapted to elevate all the needles to effect a yarn taking and subsequently a knitting operation.

As the needle actuating mechanism continues rotatably about the cylinder, the position of the said auxiliary and main tuckers will obviously determine the subsequent operations of the needles. The arrangement illustrated in Figure 6 shows that the feed from 74 is to be discontinued. Under these conditions, the main tucker 46 is lowered, and the auxiliary tucker 60 is maintained in its unelevated position as shown, so that the butts of none of the needles will engage either of said tuckers, but will move along a tuck position (where the hooks of the needles are below the yarn-engaging level) until they will engage the said separating cam 58, to be drawn downwardly, thereby not performing a knitting operation but creating a float inasmuch as the yarn from eyelet 74 has not been drawn downwardly by the needles. The said yarn is picked up by the picker 100 bringing it in a horizontal position within the throat of the cutting and clamping blades, whereupon, at a predetermined time, the cutting and clamping operation is effected. This occurs when the stationary pin 118 causes an operative rotation of the cross member 112 in a manner to be more fully hereinafter explained.

Figures 7 to 9 inclusive illustrate a series of steps just prior to and including the disengagement of a feed. The long butt needles illustrated have, just prior to their position shown in Figure 7, been lifted from a welt position under the influence of the riser cam surface 56. At this time the tucker trip 152 is elevated in the manner aforesaid through the action of arm 150, thereby causing a corresponding elevation of the auxiliary tucker 60, the main tucker 46 being in its raised position inasmuch as it had been functioning as a means of elevating all needles to latch-clearing position to effect a knitting of its yarn. The elevation of the auxiliary tucker 60 causes an elevation of the said long butt needles to latch clearing position, until engaged by the stitch cam 62 to complete the knitting operation of the previous low butt needles, as shown in Figure 8. Referring back to Figure 7, it will be seen that the upper pin 50, actuated by the double bell crank 176, is in abutting engagement with the rocker foot 42, a continued movement of the cam ring causing an operative tripping of said rocker foot and a consequent lowering of the main tucker 46 as shown in Figure 8. In the meantime the auxiliary tucker 60

has again been returned to its lowered position after it had passed the tucker trip 152, as illustrated. As appears from Figure 8, all short butt needles following the long butt needles shown being drawn by the stitch cam 62, will remain in their tuck level unelevated, and will be depressed by the auxiliary or separating cam 58, all such needles being hence maintained at below yarn taking level. Hence upon a continued rotary operation of the machine, a float will be formed between the last (right) long butt needle and the eyelet, as shown in Figure 9.

It is at this point that the pick, cut and clamp mechanism is operated through the medium of the cross member 112, as will now be explained. It will be seen that in Figure 8 the arm 116 of the cross member 112 has approached close to the pin 115 which has been projected into the path of said arm 116 through the operative action of link 164, which in turn has been actuated through the action upon arm 128 of the links on the chain 120a. Upon a continued movement of the cross member 112 about the cylinder, the said arm will engage the pin 115, whereupon a rotary movement of 90° of member 112 will be produced to bring the arm 116 into the position shown in Figure 9. When this occurs, the pick, cut and clamp mechanism is operated in the manner hereinabove described, the picker bringing the float 214 (Figure 9) to a horizontal position between the jaws of the cutting and clamping blades, whereupon the yarn is cut and held clamped in a horizontal position as indicated by the dotted lines at 218, leaving suspended a tail end 216.

Upon a further continued operative movement of the cross member 112 about the cylinder, the pin 120 on arm 114 will come into engagement with the stationary pin 118, to cause a further rotation of the cross member 112 about its axis, this rotary movement having no immediate effect upon the associated mechanism, but merely serving to bring the arm 117 into a vertical position ready for operative engagement with pin 115 at any subsequent selected time.

For best operative results, it is apparent that the severance of the yarn 214 should be effectuated as late as possible, in order to provide a sufficiently long tail yarn to prevent an unravelling of the last knitted wale. It will also be observed that the operation of either pins 50 or 52 and pin 115 occurs preferably simultaneously.

Figures 10, 11 and 12 illustrate a series of steps just prior to and including the engagement of a new feed. As shown in Figure 10, the tucker trip 152 has been momentarily raised so as to elevate the auxiliary tucker 60, whereby all the long butt needles shown on the figure will be raised to latch clearing position, preparatory to taking the yarn 226. It will be noted that the main tucker 46 is in its lowered position inasmuch as the feed of yarn 226 was not in operation, being held clamped between the clamping jaws as shown. It will also be observed that the lower pin 52 is in engagement with the rocker foot 42 so that upon a continued operative rotation of the cam ring, the said rocker foot will be operatively rotated to the position shown in Figure 11, thereby also elevating the main tucker 46. As the said long butt needles successively engage the yarn, their butts come into engagement with the stitch cam 62, carrying them downwardly preparatory to the performance of a knitting operation. Inasmuch as the main tucker 46 has been elevated during the time the long butt needles are passing thereover, it is in a position to operatively intercept a stepped up angulated trail of short butt needles extending along the path 227, whereby said short butt needles will all be elevated to a latch clearing position to take the yarn 226, to be subsequently depressed by the stitch cam 62 preparatory to the knitting operation to be completed after the yarn 226 will be released from the clamping mechanism thereby performing a continuous and uninterrupted knitting operation. When the yarn 226 is engaged by all the long butt needles as shown in Figure 12 and sufficiently knitted to prevent any accidental withdrawal thereof when the clamping blades are released, the cross member 112 is operatively actuated to cause an opening of the clamping blades, as shown in this figure, and permit the release of the yarn for a continued feeding operation. The said rotation of member 112 is effectuated when the arm 117 comes into engagement with the forwardly projected pin 115, as shown in Figure 12, the projection of said pin being timed in accordance with the setting of the links on said chain 120.

In both of the operating conditions above described in connection with the discontinuance of the feed and the bringing in of a new feed, it will be noted that the said long butt needles are always raised in advance of either of the above operations, that is, they are raised in advance of the raising of the main tucker 46, and also in advance of lowering of said main tucker, thereby providing a definite termination point for the yarn coming in and yarn going out. It is thus apparent that a seam area is produced containing overlapping courses of beginning and end portions of the spiral.

It should at this time be stated that if merely a main tucker were used to operate with conventional short butt needles, an up or down going trail or stepped arrangement of needles would be presented, whereby the oncoming separating or auxiliary cam 58 would so intercept said trail as to cause the upper needles to take yarn and the lower needles to be free from the yarn feed, thereby producing a rather poorly defined seam region. With our invention, however, the said trail or stepped arrangement of butts during the change-over period is completely eliminated, the discontinuance of one feed and continuance of another taking place only when the long butt needles are elevated. It is thus obvious that only the selected needles will pass over the separating cam 58 for taking yarn, all others passing therebelow for non-feeding conditions, thereby providing a well defined seam area of uniform width.

If the machine embodying the above invention contains thirty-two feeds, it obviously is capable of producing fabric with thirty-one feeds of one color and one feed of another color operating simultaneously, thereby producing for every revolution of the machine thirty-one courses of body yarn plus one colored stripe. It can also produce wider stripes of many courses and narrower body portions. While stripes are being knit, all thirty-two feeds are in operation, and when background for the body portion is being knit, the number of feeds in operation per revolution is thirty-two less the number of colored yarn feeds which the machine is set to produce. It is hence apparent that a machine embodying our invention is capable of producing a great variety of striped fabrics at a high rate of production.

Figure 13, which represents a piece of fabric knitted by the apparatus above described, illustrates a striped knitted fabric produced on a thirty-two feed machine and comprising a number of different colors constituting the stripe. Beginning at point A, three selected colors are introduced at the beginning of the long butt needle zone, then three succeeding feeds of body yarn are knitted out at B, and three other selected colors, again beginning at the left of the long butt needles, are knitted in at C. This is followed at D by a plurality of courses constituting the background yarn. The operation is continued to form spirals as indicated, the discontinuance of the various yarns being effected at the right side of the seam to form an overlapping seam of a width Z indicated by two arrows. The product is thus a tubular knitted fabric having a fully knitted seam which is flexible and yieldable, inasmuch as there is no intertwining of yarn at the region of the seam as in the case of other conventional striping machines hereinbefore referred to. As shown in Figure 15, the only difference between the section of yarn at this region and in any other region (indicated at Figure 14) is that a slight gathering or warping occurs where the colored yarns are engaged and disengaged. And inasmuch as the fabric is made without any interruption to the knitting operation, no holes in the seam are present. It is thus apparent that the knitted fabric is particularly adaptable to being drawn through spreader mechanisms or other processing apparatus to which knitted fabrics are generally subjected after their fabrication because of the structurally strong yet yieldable and flexible nature of the seam.

It is of course understood that other additional forms of apparatus and adaptations of the method can be employed beyond and in addition to those hereinbefore described, all within the scope of the appended claims.

What we claim is:

1. In a circular knitting machine for the production of striped fabrics, a needle cylinder, a plurality of needles operatively positioned thereon including a group of seam-producing needles, needle elevating and depressing means including a movable main tucker engageable with all said needles for operatively actuating them to produce knitted stitches, an auxiliary tucker engageable only with said seam-producing needles for operatively elevating them, and means for successively actuating both of said tuckers, said auxiliary tucker being operable in advance of said main tucker.

2. In a circular knitting machine for the production of striped fabrics, a needle cylinder, a plurality of needles operatively positioned thereon including a group of seam-producing needles, needle elevating and depressing means engageable with all said needles for operatively actuating them to produce knitted stitches, a plurality of yarn feeds cooperably positioned with respect to said needles, cutting and clamping means operatively associated with each of said feeds for cutting the yarn from its feed and clamping the terminal portion of said yarn, an auxiliary tucker engageable only with said seam-producing needles for operatively elevating them, and means for successively actuating during each revolution of the machine first said auxiliary tucker and then said cutting and clamping means.

3. In a circular knitting machine for the production of striped fabrics, a needle cylinder, a plurality of needles operatively positioned thereon including a group of seam-producing needles, needle elevating and depressing means including a movable main tucker engageable with all said needles for operatively actuating them to produce knitted stitches, a plurality of yarn feeds cooperably positioned with respect to said needles, cutting and clamping means operatively associated with each of said feeds for cutting the yarn from its feed and clamping the terminal portion of said yarn, an auxiliary tucker engageable only with said seam-producing needles for operatively elevating them, and means for independently actuating both of said tuckers and said cutting and clamping means, said auxiliary tucker being operable in advance of either said main tucker or said cutting and clamping means during an operative revolution of the machine.

4. In a method of knitting striped fabric on a circular knitting machine containing a group of seam-producing needles at a selected region of the machine and body-producing needles about the rest of the machine, the steps of elevating only said seam-producing needles to a latch-clearing position, elevating succeeding needles to a tuck level, bringing said seam-producing needles into engagement with the yarn from an adjacent feed and lowering these needles to a welt position to form a float, cutting said float and clamping the terminal thereof.

5. In a circular knitting machine for the production of striped fabrics, a cam unit mounted on the cam ring of the machine, said unit comprising a block, a raising cam attached to the inner surface thereof, a main tucker and spaced therefrom laterally and radially away from the cylinder an auxiliary tucker, said tuckers being vertically movable and having inclined needle-engaging surfaces.

6. In a circular knitting machine for the production of striped fabrics, the combination according to claim 5, further provided with a shaft rotatably mounted within said block and containing a rocker foot attached thereto, the inner terminal of the shaft containing eccentric means operatively associated with said main tucker for vertically actuating it upon a rotation of the shaft, and means for operatively engaging said rocker foot.

7. In a circular knitting machine for the production of striped fabrics, the combination according to claim 5 in operative association with a movable tripping block engageable with said auxiliary tucker, and means for intermittently actuating said block for vertically actuating said auxiliary tucker.

8. In a circular knitting machine for the production of striped fabrics, the combination according to claim 5, further provided with a shaft rotatably mounted within said block and containing a rocker foot attached thereto, the inner terminal of the shaft containing eccentric means operatively associated with said main tucker for vertically actuating it upon a rotation of the shaft, means for operatively engaging said rocker foot, a stitch cam slidably movable vertically on said block, yieldable means urging said stitch cam upwardly, and depressing means associated with said shaft and operatively connected with the stitch cam for depressing said cam against the action of said yieldable means at a predetermined point during the rotary movement of said shaft.

9. In a circular knitting machine for the production of striped fabrics, a cam unit mounted

on the cam ring of the machine, said unit comprising a block, a raising cam attached to the inner surface thereof, a main tucker and spaced therefrom laterally and radially away from the cylinder an auxiliary tucker, said tuckers being vertically movable and having inclined needle-engaging surfaces, a stitch cam mounted on the block, and a separating cam interposed between said main tucker and said stitch cam.

10. In a circular knitting machine for the production of striped fabrics, a unit including a yarn picker, yarn cutter and a yarn clamper, the cutter containing a pair of cooperating cutting blades and the clamper containing a plurality of cooperating clamping blades, the jaws of said blades being in registry when in their open positions, the picker comprising a pivotally mounted arm with a yarn-engaging terminal, said terminal being movable, upon an operative rotation of the picker arm, to the level of the jaws of said blades whereby the yarn engaged thereby will be held within said jaws in position for the subsequent cutting and clamping operations, rotary means for actuating first said picker and then said blades into their operative positions, said rotary means being rotatable to a plurality of predetermined positions, the blades and picker being held inoperative at certain of said positions and operative at a predetermined one of said positions, and means for successively revolving said rotary means at predetermined times to each of its said positions.

11. In a circular knitting machine for the production of striped fabrics, a needle cylinder, a plurality of needles operatively positioned thereon including a group of relatively long-butt needles, needle elevating and depressing means including a movable main tucker engageable with all said needles for operatively actuating them to produce knitted stitches, an independently movable auxiliary tucker removed radially farther from the cylinder than the main tucker and engageable only with said long-butt needles for operatively elevating them, a movable tripping block engageable with said auxiliary tucker, a unit including a yarn cutter and a yarn clamper operatively engageable with the yarn of an associated feed, independent rotary means for actuating said main tucker and said cutter and clamper, and selective intermittent actuating means operatively connected with said rotary means and said tripping block for simultaneously operating said main and auxiliary tuckers and said cutter and clamper.

12. In a circular knitting machine for the production of striped fabrics, a unit including a yarn picker, a yarn cutter and a yarn clamper, the cutter containing a pair of cooperating cutting blades and the clamper containing a plurality of cooperating clamping blades, the jaws of said blades being in registry when in their open positions, the picker comprising a pivotally mounted arm with a yarn-engaging terminal, adjustable means to operatively actuate said picker to bring the said terminal thereof into a selected position adjacent the jaws of said blades whereby the yarn engaged thereby will be held within said jaws in a predetermined position for the subsequent cutting and clamping operations, and rotary means for actuating first said picker and then said blades into their respective operative positions.

13. In a circular knitting machine for the production of striped fabrics, a needle cylinder, a plurality of needles operatively positioned thereon including a group of seam-producing needles, needle elevating and depressing means including a movable main tucker engageable with all said needles for operatively actuating them to produce knitted stitches, an auxiliary tucker engageable only with said seam-producing needles for operatively elevating them, and means for successively actuating both of said tuckers.

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