

1,189,220.

3 SHEETS—SHEET 1.



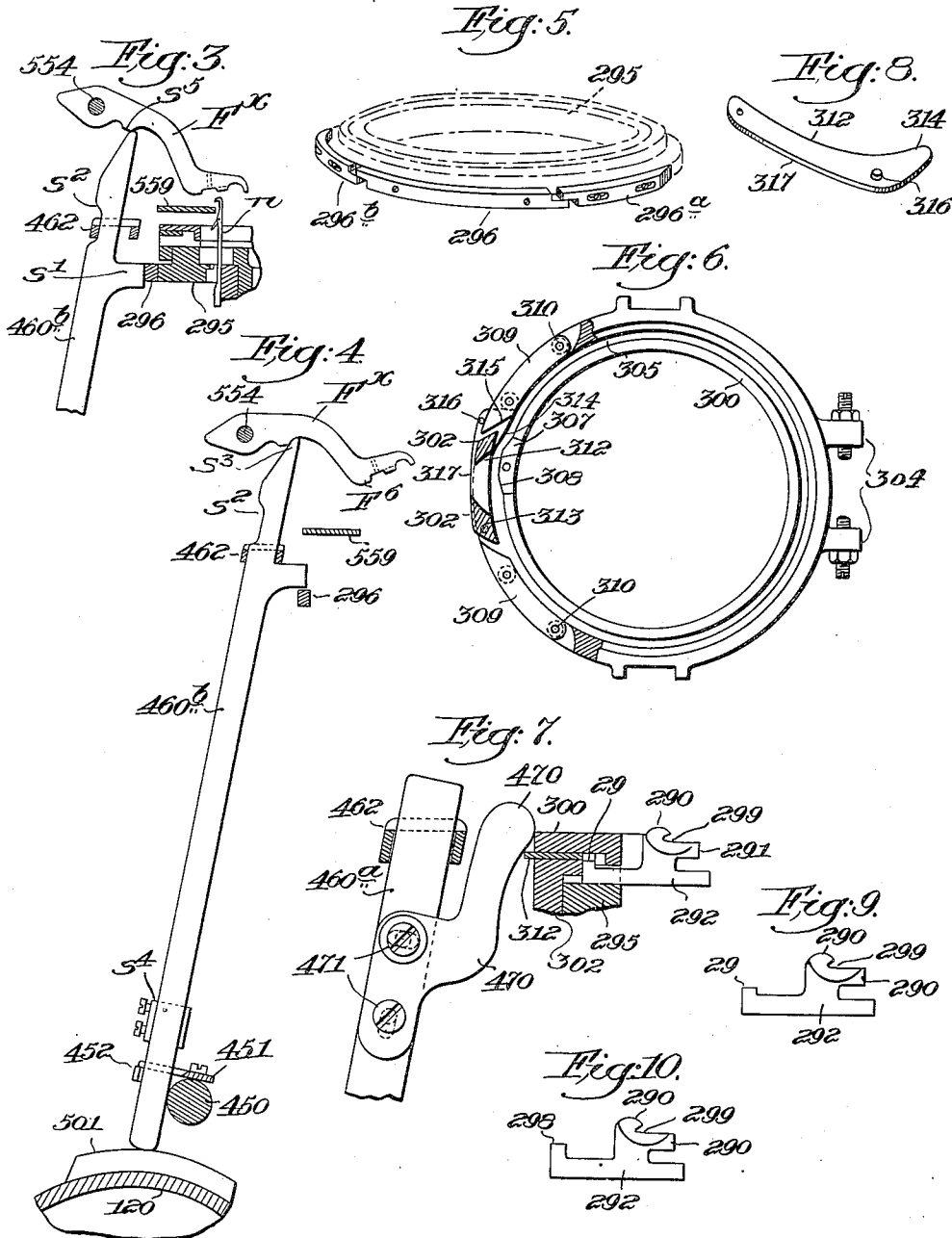
Inverdon;
 Robert W. Scott,
 by Robert C. Cline
 his attorney

R. W. SCOTT.
 STITCH LENGTH MECHANISM FOR KNITTING MACHINES.
 APPLICATION FILED NOV. 7, 1914.

1,189,220.

Patented June 27, 1916.

3 SHEETS—SHEET 2.



Witnesses,
 G. B. Norton.
 E. G. Marshall.

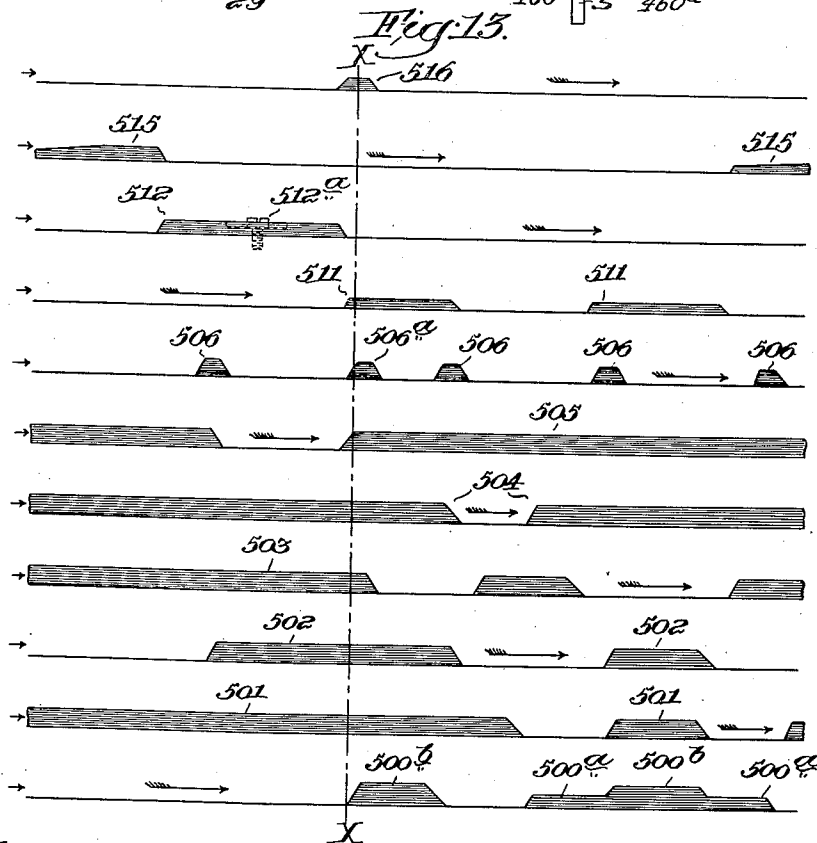
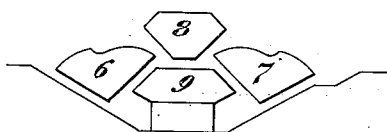
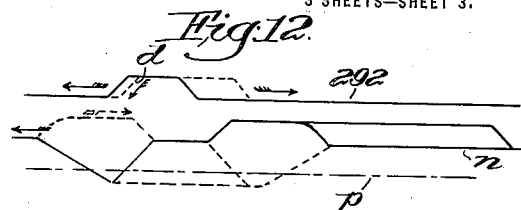
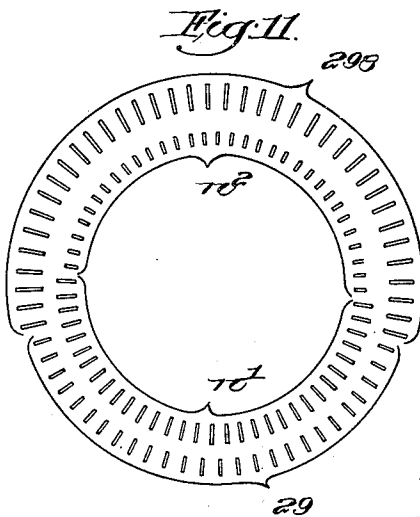
Inventor:
 Robert W. Scott
 by Robert C. Cline
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3 SHEETS—SHEET 3.



Witnesses,
 Edward D. Allen
 A. B. Norton.

Inventor:
 Robert W. Scott
 by Robert C. Ouel
 his attorney

UNITED STATES PATENT OFFICE.

ROBERT W. SCOTT, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO SCOTT & WILLIAMS, INCORPORATED, OF CAMDEN, NEW JERSEY, A CORPORATION OF NEW JERSEY.

STITCH-LENGTH MECHANISM FOR KNITTING-MACHINES.

1,189,220.

Specification of Letters Patent. Patented June 27, 1916.

Original application filed February 3, 1913, Serial No. 746,070. Divided and this application filed November 7, 1914. Serial No. 870,797.

To all whom it may concern:

Be it known that I, ROBERT W. SCOTT, a citizen of the United States, and resident of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Stitch-Length Mechanism for Knitting-Machines, of which the following is a specification.

My invention relates to mechanism co-operating in a knitting machine to control the length of stitch in the fabric produced.

My invention is illustrated in connection with a circular knitting machine operating to produce articles of hosiery having, if desired, heel and toe pockets, sectional reinforcements extending the whole or a part way around the tubular product of the machine, and comprising connected parts of different kinds, colors or arrangements of yarns, which machine may correspond to the disclosure of my application Serial No. 746,070 filed Feb. 3, 1913, (Letters Patent No. 1,152,850, dated September 7, 1915) of which this application is a division.

In the accompanying drawings, Figure 1 is a vertical section through the cam ring and needle cylinder of a machine provided with my devices; Fig. 2 is a detail front elevation; Fig. 3 is a detail similar to Fig. 1 showing a different position of the parts; Fig. 4 is a similar detail showing another position; Fig. 5 is a detail perspective showing cams forming part of the device for splicing; Fig. 6 is an under plan view of the web-holder cam ring; Fig. 7 is an enlarged detail section showing the special web-holder cam and part of its adjusting means; Fig. 8 is a perspective of the special web-holder cam; Figs. 9 and 10 are detail elevations showing the two different kinds of web-holders; Fig. 11 is a diagram showing one arrangement of long and short butt needles and web-holders; Fig. 12 is a diagram illustrating the relative movements of needles and web-holders; Fig. 13 is a diagram development of one arrangement of some of the operating cams on drum 120, and Fig. 14 is a horizontal detailed section above comb 462.

The machine in connection with which I have elected to show my new devices is an automatic hosiery machine more fully set out in my said application, comprising a bed-plate D having an annular bearing in which a bevel gear 30 is held for rotation

and against vertical movement, but it is evident that the devices about to be described are independent of the particular form of machine to which they may be attached, and I do not limit myself to their use with said machine.

Bevel gear 30 carries a longitudinally grooved needle cylinder 260, Fig. 1, having independently movable needles therein, which may be tensioned needles, laterally bent or otherwise caused to work stiffly in their grooves, and may comprise a short butt series n^2 and a long butt series n^1 for the usual stocking-knitting purposes.

The heads of the projected knitting needles are surrounded by a latch guard ring shown generally at 550.

Two fixed diametrically opposite posts or standards are erected upon the bed-plate D. That standard 401 at the rear of the machine is substantially X-shaped to provide at its bottom the opening 461 and at its top two upstanding lugs bored to carry a horizontal stud 552 upon which and within said lugs are pivoted the rearwardly extending arms 553 of the said latch guard ring 550. This ring is an open drum shaped casting having between said arms 553 a wide parallel walled slot central on a plane radial to the needle cylinder to provide a space for the operation of the yarn guides F, which are journaled on a fixed stud 554.

The slot between the arms 553 is closed at the bottom by a channel shaped throat-plate 559, from either corner of which the yarns may pass directly to needles traveling in the grooves between the top center cam 8 and the bottom center cam 9, or down the faces of either stitch cam 6 or stitch cam 7, Figs. 1 and 12.

The machine has the remaining adjuncts of a circular hosiery knitting machine of which the members immediately concerned will be treated more in detail below.

Motion is communicated to the knitting head in any suitable manner, such as that disclosed in my said application, Serial Number 746,070. In said machine the times of operation of the various devices are controlled by a pattern mechanism including a main pattern shaft 80, Fig. 1, advanced intermittently through one revolution for each article made. On a shaft 76 a pattern drum 120, Figs. 1 and 12, having an attached gear 121 is mounted for rotation

thereon by an idler gear 123 meshing with a gear 122 similar to gear 121 fast on shaft 80. Motions of shaft 80 are thereby transmitted without change to drum 120.

5 Drum 120 carries changeable pattern cams or other indications determining the operation of certain parts of the machine including the stitch length mechanism and the yarn-feeding mechanism.

10 Referring to Fig. 1, a rigid stud 450 extends parallel with the overhanging shaft 76 and in front of the vertical plane of said shaft. A comb or sley 451 is attached to the stud 450, for the reception of a series of
15 rigid thrust bars 460, which bars are beveled at their lower ends, and which rest against the face of the cam drum 120, are spaced apart by the slots in the comb 451, and are prevented from moving forward with the
20 drum by the stud 450. Said thrust bars 460 extend upward through an opening 461 provided through the shelf or bed D and the standard 401 at the rear of the machine, to a comb 462 mounted on lugs on the standard
25 401 at the rear of the knitting head. Said thrust bars are moved by cams 500, 501, &c., attached to drum 120.

Bar 460^a, which may be any one of the series, as shown in Figs. 1 and 14, coöperates
30 with the ring of cams 500^a, 500^b, to control a device 565 for closing the yarn-feeding gap in the latch-ring when moved by a cam 500^b, and carries a cam arm 470 attached for adjustment by screws 471, Fig. 7, taking
35 into slots, for operation of a special web-holder cam below described when moved by a cam 500^a; and when resting against the face of the drum operates neither of said devices. Bar 460^a may be cut off above comb
40 462 as shown.

Bar 460^b, which may be any one of the series, actuates a splicing yarn-guide, referred to again below.

Bars 460^c, 460^d, 460^e, 460^f may be employed
45 for working yarn changing yarn-guides as illustrated, or for other purposes; bar 460^e as illustrated works a yarn-cutter and clamp mechanism 606, and another bar extends upward behind comb 462 to operate an over-
50 head take-up and tension device (not shown).

To determine stitch length at all of the needles, the draft of the needles is adjusted with respect to knocking-over instru-
55 ments, such as web-holders, and relatively fixed knitting cams.

The central part of the gear 30 is cut away to provide a free opening through which the forming fabric descends, and is surmounted
60 by sleeve 251 upon which the needle cylinder 260 is removably mounted. The cylinder 260 which may be of any approved construction is held to rotate with the sleeve 251 by the key 252 sliding in a longitudinal key-
65 way on the inner side of said cylinder 260.

To provide for vertical adjustment of cylinder 260 the gear 30 is bored through preferably in three places to receive supports 256, which may be hard steel pins, all of the same length. The bores 255 are in line with the bottom of the needle cylinder, which
70 freely rests upon the ends of said pins by gravity, and by reason of the stress due to the coöperation of needles frictionally held in their grooves with fixed cams whose advancing slopes are flatter than their retracting slopes, when the machine is running.

The pins 256 in turn rest upon, and by reason of the motion of the gear 30, rotate with respect to a ring 257, which may be
80 a hardened and polished steel ring, which ring has a bearing within the inner machined face of a depending cylindrical flange 259 of the bed plate D. The ring 257 is vertically movable within said flange 259
85 by the vertical movement of a hollow tubular column 280 concentric with the knitting axis which fits within said flange 259 at its upper end and upon which the ring 257 rests.

The knocking-over plane below which old loops may not be carried is determined by the upper surface of the upper inwardly extending arms 291 of web-holders 292, Figs. 9 and 10, movable in the grooves of a radially grooved bed or dial 295 rigidly
90 mounted upon the extreme upper end of the outer face of the needle cylinder, upon a flange 95 having deep milled grooves in line with the needle grooves to provide
100 spaces for the removal of the needles. Some of the web-holders 292 are provided with long butts 298 and some with short butts 29 as shown in Fig. 9.

The grooves of the web-holder bed or dial 295 stand midway between spaces occupied by the needle grooves, and the inboard ends of the web-holders 292 are received and
105 guided by a nosing 297 fast in the upper end of the needle cylinder 260. The upper surface of the inwardly projecting upper arms 291 of said web-holders is usually sloped upwardly at an angle as shown at 299. This angle begins at a point slightly in advance of the web-holding hooks 290, which
115 may be of the usual form and perform the usual functions.

By reason of the attachment of the web-holder bed 295 and the nosing 297 to the needle cylinder 260, the knocking-over plane
120 defined by the upper surface of the arms 291 of the web-holders may be lifted or lowered to increase or decrease the stitch length at all of the needles with respect to the bed D, the fixed cam cylinder 271, and the knitting
125 cams carried thereby, by the agency of the pins 256, the movable ring 257, the column 280 and automatic means coöperating with said column.

I provide on the stud 450 a two armed 130

lever 281, Fig. 1, having a sleeve bearing on said stud and a depending head 282 resting near the front face of the drum 120. Said head 282 carries four plungers 283 having adjusting screws 284 and lock nuts 285. Said plungers follow the respective cams 511, 512, 515 and 516 on said drum. The other arm of the lever 281 terminates in a flat 286 taking on the underside of a lug 287 screwed on the column 280. The lower end of said column rests freely in a ring bearing 390 bolted on the underside of the table A, but is restrained from falling by the cam lug 391 screwed thereon, said cam lug having a recess with a sloping face 392 resting upon a plunger 393 fastened for adjustment by a set screw in a vertical bore in said ring 390. In a boss in the cam lug 391, and projecting radially toward the front of the machine I provide a knee lever 394 by means of which the column 280 may be rotated to cause the cam recess 392 to ride up the plunger 393 to elevate the needle cylinder through ring 257 and the pins or supports 256 when desired; for instance, so as to position the web-holders to guide a transfer cup when transferring a rib top.

Referring now to Fig. 13, for one specific use, a previous stocking may have been completed when one of the plungers 283 is under the influence of the cam 516, which elevates the lever 281 to make comparatively loose fabric for the "loopers-rounds" following the open toe. Upon the advance of the pattern drum 120, for instance to begin a new stocking, the cam 512 will have influenced its plunger 283 to adjust the stitch length for the garter top of the stocking, which may be of a different yarn or multiplicity of yarns necessitating a different length of stitch. The cam 512 is for this purpose provided with a screw 512^a to enable an adjustable local variation of the stitch length at this time.

The pattern drum may now advance without altering the stitch length, the position of the lever 281 from this point and thereafter being under the control of the cam 515, which is sloped toward its following end, to permit the gradual fashioning of the leg of the stocking by several successive short advances of the drum 120. No further change in the stitch length through the intervention of column 280 will occur until the knitting of the heel and toe, during which said column may be lifted by the cams 511, to accommodate a heavier yarn fed at this time.

Mounted on a reduced portion 301 of the web-holder bed 295 by means of a depending flange 302, and hold-down clamps, a web-holder cam ring 300 is adjustably held against rotation with the needle cylinder in either direction by stop-screws in lugs 304 straddling one of the supporting posts for the latch ring, and permitting a suffi-

cient lost motion to render the adjustments for opposite rotations independent of each other.

The underside of the web-holder cam ring (see Fig. 6) is provided with a concentric groove 305 for the control of the butts 298 and 29 of the web-holders 292, as usual. At a point opposite the lugs 304 said ring 290 is provided with a cam portion, which cam presents two withdrawing inclines 307, 308 to give the web-holding hooks 290 an outward radial movement at the knitting cams. The incline 308 is displaced toward the following stitch-cam, in the direction for rotary work (Figs. 6 and 12) to delay the withdrawal of the web-holders until after the passage of the needles down the face of the top center cam 8.

Adjustable cams 309 pivoted on each side of the outthrow cam 306 determine the inward throw of the web-holders 292, which movement is so related to the stitch cams as to cause full insertion of the web-holders at or immediately after the point at which the needles have fully descended. Said cams 309 are housed in deep slots milled through the depending flange 302, which flange is also cut away at 310 to provide a discharge opening for broken parts.

I have equipped my machine with devices for sharply changing the length of stitch between two or more adjacent segments of the tube of fabric, by the provision of means to change the relation of those needles desired to knit the lengthened wales to their cooperating abutments or knocking-over instruments at the time when the needles are active to draw their stitches.

I am aware of devices in the prior art for locally slackening the stitches in a segment of a knit tube, but so far as I am informed said devices have depended upon moving the movable element of the machine, either the knitting cams for actuating all of the needles, or the needle carrier, at a certain part of each revolution, to vary the extent to which the needle recedes, and thereby draw off more yarn. Such devices cause the slackened area to vary irregularly in position laterally of the tube after slight wear of the machine parts, necessitate an additional system of working parts which must be operated at least twice in each revolution of the machine, and make stitches at each end of the slackened fabric of variable and intermediate length, due to the slope of the knitting cam, so that the edge of the slackened area is uncertain and vague.

My new device comprises means, to be adjusted at the beginning and end only of the part of the tube containing the slackened area, for acting on a special part provided throughout one or more segments (which part may be an operating butt of a different length) on one member of each pair of instruments working together to draw the

stitch, thus to determine a relation of said instruments to each other in one segment sharply different from the relation to each other of the instruments of the adjoining segment. I further provide means for readily adjusting the degree of slackness in the slackened area.

On the web-holder cam ring 300 opposite the outthrow cam 306, and opposite the deepest part of the groove 305 the flange 302 is milled through as best shown in Figs. 6 and 7 for the reception of a thin cam 312 which is pivoted at 313 in one end of the slot 311. The active face 314 of the cam 312, when it is swung inward at its free end toward the axis of the machine is close to and in advance of the active face 315 of that cam 309 which is the inthrow cam for the web-holders during rotary knitting. A stop pin 316 taking against the periphery of the web-holder cam ring 300 determines the extreme adjusted position of the cam 312. Said cam 312 is of a thickness and in a position to encounter only such web-holders 292 as are provided with long butts 298. Its effect when in its adjusted position is to advance said long butt web-holders at an earlier time with respect to the loop-drawing movement of the needles than would be occasioned by the face 315 of the cam 309, to position the hook 290 and slope 299 of the web-holders within the plane of the needles at the knitting point, and thus to determine to an adjustable degree drawing a longer loop by the needles at the web-holders so moved, as indicated at *d*, Fig. 12. I attribute the effect of said movement of the web-holders within the plane of the needles at an earlier time to increase the length of stitch for the same draft upon the needles, to stopping or lessening the extent to which a preceding needle is robbed of yarn taken by a following needle. Yarn from an adjacent following needle is readily yielded from the source of supply and it is well known that if the adjacent preceding needle is not permitted to return from its extreme stitch-forming position as when there is a flat on the lower end of the stitch cam, no robbing of yarn can take place from or through said needle, and all the yarn that enters into the stitch being formed must come direct from the source of supply and longer stitches will result from the same draft. If, however, the other member of the stitch-forming pair, the web-holder, is given a drawing movement at or immediately following the stitch-forming point this comes to the same thing—robbing is stopped and longer stitches are formed for the same draft.

The movement inward of the cam 312 to advance the active movement of the web-holders into conjunction with the stitch-drawing movement of the needle thus provides one ready means to stop robbing of the

preceding stitch. The effect upon the stitch-length of movement inward of cam 312 is greater in extent than the increased elevation of slope 299 will account for, the inward adjustment of said cam 312 providing means to widely vary the length of stitch at those needles paired with web-holders having long butts. While I prefer to employ web-holders with slopes 299, their use is not essential to the effect of the cam 312 to increase the length of stitch when moved inward. The cam 312 is free upon the pivot 313 and is moved outwardly to its inoperative position by the thrust of the web-holder butts except when it is interfered with by connections in contact with the outer edge of said cam 312. Said connections conveniently comprise said bar 460^a and cam arm 470, which, when bar 460^a rests on the face of drum 120 is just below the face 317 of cam 312, but when positioned by a cam 500^a is in contact with said face 317 to move said cam 312 inward to an extent determined by the adjustment of arm 470 at screws 471. The sloping face 314 of cam 312 encounters the butts 298 at a virtually earlier or later time depending upon its radial position as will be obvious from Fig. 6. Web-holders 298 may be placed at any desired relation to the needles n^1 , n^2 , for instance as shown in Fig. 11 throughout the segment occupied by the shorter-butt needles n^2 employed for the heel, sole, toe and back of the leg of a stocking. Merely to illustrate the independence of the segment capable of being slackened by said web-holders from the segment knit by the respective kinds of needles, said web-holders 298 are shown as overlapping the needles n^2 at each end, but it will be obvious that such web-holders may be associated with any part of the needles n^1 or n^2 , and determine either a single or a plurality of separated segments of the knit tube throughout which the length of stitch will be increased uniformly to a predetermined extent whenever cam 312 is made operative.

The times of operation of the cam 312 with respect to the knitting operations will be determined by the relative positions of cams 500^a on drum 120, and may be any desired times. As shown in Fig. 13, cams 500^a are provided to slacken the back of the tube knit at the ankle and the sole of the foot, in association with devices for feeding a splicing yarn at the area slackened only. But I may employ the described devices in connection with yarn changes to slacken the fabric in the course or in the courses preceding or following courses containing yarns overlapped at the point of exchange, and for other purposes requiring local slackening of the fabric. I prefer to employ for splicing in combination with the said devices for local slackening the sectional splicing devices herein illustrated, forming a part of the

disclosure of my said application, Serial No. 746,070, and also described and claimed in continuing application, Serial No. 845,844 filed June 18, 1914, which I will now briefly describe to explain the relation of said slackening and splicing means.

The movable yarn guides F, above mentioned, rest under the influence of springs F^s, their inner operative ends normally standing on throat plate 559. One series F' of said yarn-guides is employed for yarn changing. Thrust-bars 460^c, 460^d, 460^e, and 460^f are independently movable against the undersides of said guides F' in the desired order by cams 502, 503, 504, 505 on drum 120 to elevate the inner ends of said guides above and within the needles, the yarn thus removed from the needles passing under a guide 604 and above an internal guide plate 602, to be clamped and severed by a severing and clamping device 606, operated through thrust-bar 460^g and cams 506^g on said drum 120.

One yarn guide F, which may be any one, such as that at the left of the series, F^x, is utilized to knit the sectional splicing of the stocking, as for a high-splice at the back of the heel, or a reinforcement at the sole. This yarn guide F^x is shown as associated with the second thrust-bar 460^b, which bar is unlike its fellows in the provision upon it of a lug s upon the face of the bar at a point beneath the comb 462, and normally above the plane of the web-holder dial 295. Said bar 460^b is also provided with a rounded nose s³, preferably in a plane farther removed from the pivot 554 for the yarn guides than are the rounded upper ends of the remaining thrust bars; and with a recess s², which when said bar 460^b is lowered is opposite the rear member of the comb 462. Movement of the bar 460^b toward the rear of the machine through a small arc is thus permitted when said bar is in its lowermost position, which is that illustrated in Figs. 1 and 3. Upon said bar 460^b, at a point near the comb 451, I provide an adjustable stop lug s⁴ in a position to encounter the upper face of said comb 451 when said bar 460^b is not elevated. This structure provides at the comb 451 a pivot point upon which the bar 460^b may swing through the limited arc allowed by the recess s², whenever the cams 501 on the drum 120 permit said bar to drop to its lower position. Coöperating with the nose s³ of said bar I provide upon the yarn guide F^x a cam lug s⁵.

On the flange of the web-holder dial 295 (see Figs. 2 and 5) and thus rotating with the needle-cylinder and needles and maintaining a constant angular relation to the web-holders, I provide an attached cam 296 having adjustable end faces 296^a and 296^b. As will be seen by reference to Figs. 1 and 3, when the bar 460^b has been permitted to

drop, its lugs s' will be in the path swept by the cam 296. The end faces 296^a and 296^b may be adjusted or replaced by others to vary the peripheral segment desired to be sectionally spliced. This segment may be more or less than a diametrical half of the tube.

The operation of the splicing yarn guide F^x will be apparent. Upon the passage from under the bottom end of the bar 460^b of one of the cams 501, the yarn guide F^x which before has been held in an elevated idle position by the upward thrust of the said bar, will be permitted to drop until its feet rest upon the plate 559, thus placing its yarn in action at the needles; but upon the stops s⁴, now resting upon the lower comb 451, as a center, permitting the nose s³ in co-operation with the lug s⁵ to throw the splicing yarn guide sharply to its idle position at a predetermined needle, and upon the end of the cam 296 running off the lug s', the spring F^s will restore the splicing yarn to operation at another predetermined needle.

The cam 296 is a direct attachment of the web-holder bed, so that its length may correspond to the series of long butt web-holders 298 in order to enable the spliced loops, and only these loops, to be locally elongated by the above described devices coöperating with said long butt web-holders. I am thus enabled to associate the local variation in the length of the stitch with the area spliced, with the most rigid accuracy.

It will be noticed that I have shown in Fig. 13 cams 501 having gaps to introduce the splicing yarn through the segment measured by the high butt web-holders and the cam 296 at such times as to high splice the rear of the knit tube from a point above the heel, and the sole from the end of the heel to a point corresponding to the introduction of the yarn of guide controlled by cam 504 to reinforce the entire tube of fabric near the toe. But it will be apparent that my devices are readily changeable by moving cams 501, or substituting others for them, to place the splicing at any desired point.

In operation, as will now be apparent, the pattern mechanism comprising the drum 120 will determine through connection 280, 281 the position of the knocking-over plane with respect to the stitch-forming wave in the needles determined by the relatively fixed knitting cams, to control at proper times for the production of the fabric desired the stitch-length at all of the needles; said pattern mechanism will further determine, through connection 460^b, the operation of the sectional splicing device; and said mechanism will further determine, at the same time as the operation of the splicing device, or at any other desired times, the operation of the connection 460^a to determine the uniform local elongation of all

the stitches in the part of the fabric spliced or other desired part thereof.

It will be observed that the cam 312, for the latter purpose, when in operation causes the advancing phase of the wave of advancing and receding motion in the web-holders to be shifted forward with respect to the stitch-forming wave given the needles by the stitch cams 6, 7 and 8, without necessary alteration in the extent of the reciprocation given to either movable part, and that this variation in the relative time of movement causes the needle-wave to lag with respect to the web-holder wave, at those parts only of the devices affected by cam 312. While I have described for said purposes the cam 312 and its connections, it will be understood that my invention is not limited thereto, it being new so far as I am aware to control the stitch-length by means operating upon the principle disclosed, as well as new to attain the useful purposes secured by any means. It will also be apparent that I have described the combination with said devices of the improved means for feeding a splicing-yarn in coöperation with the said stitch-length devices of my said application Serial No. 845,844, wherein said means is separately claimed.

What I claim is:

1. In a knitting machine, knitting and web-holding instruments and means to operate said instruments to predetermine fabric of a normal length of stitch at each coöperating pair of said instruments, in combination with means for acting upon one instrument of each pair of one or more continuous series thereof, to determine a different uniform length of stitch at a continuous series of adjacent needles.

2. In a knitting machine, means for knitting comprising instruments for drawing loops, such as latch needles, and instruments against which the loops are drawn and knocked over, such as web-holders, means for causing relative movement between said instruments to a predetermined degree to establish a normal length of stitch, and means acting directly upon each of continuous series of said instruments, to determine a locally different length of stitch at said instruments only.

3. In a knitting machine having a series of independently movable knitting instruments and a series of knocking-over instruments, devices for determining stitch-length comprising means to move one series of said instruments in a predetermined path with respect to the other series of instruments to draw stitches of a normal length, in combination with means active upon each instrument of a continuous part only of one of said series of instruments to move them in a path different from that of the remainder of said series to locally elongate the stitch.

4. In a knitting machine, needles, a needle carrier, and devices to determine a line with respect to the needles beyond which loops of yarn at the needles can not be carried, to establish the length of stitch, in combination with means to position a continuous portion of said devices at predetermined times with respect to the needles to locally vary the length of the stitch.

5. In an independent needle knitting machine, yarn-feeding means, a series of needles, a series of instruments against which said needles draw stitches, and means for actuating the members of said series successively for normal knitting, in combination with means for causing the means for actuating members of one of said series to operate at relatively an earlier time with respect to the actuation of the other series thereby, to change the length of stitch.

6. In an independent needle knitting machine, yarn-feeding means, a series of needles, a series of instruments against which said needles draw stitches, and means for actuating said series to advance and recede in coöperating waves of motion, for knitting, in combination with means for causing a part of one of said waves to lag with respect to the other wave during coöperation to knit to thereby effect change in the length of stitch.

7. In an independent needle knitting machine, yarn-feeding means, a series of needles, a series of instruments against which said needles draw stitches, and means for actuating said series to advance and recede in coöperating waves of motion, for knitting, in combination with means for causing a part of one of said waves to lag with respect to the other wave, during coöperation to knit to thereby effect change in the length of stitch throughout a part only of said series of needles.

8. In an independent needle knitting machine, yarn-feeding means, a series of needles, a series of instruments against which said needles draw stitches, and means for actuating said series to advance and recede in coöperating waves of motion, for knitting, means for causing a part of one of said waves to lag with respect to the other wave to thereby effect change in the length of stitch throughout a part only of said series of needles, in combination with means for shifting the location of the wave in said needles toward and away from said instruments to determine a different length of stitch at all of said needles.

9. In an independent needle knitting machine, yarn-feeding means, a series of needles, a series of web-holders, and means for actuating said series to advance and recede in coöperating waves of motion for knitting normal fabric, in combination with means for shifting the location of the ad-

vancing phase of the wave in said web-holders with respect to the other wave at a part only of said series of needles.

10. In a knitting machine, needles, a needle carrier, and devices to determine a line with respect to the needles beyond which loops of yarn at the needles cannot be carried, to establish the length of stitch, in combination with means to position a continuous fractional portion of said devices at predetermined times with respect to the needles to locally vary the length of the stitch, and means to feed a splicing yarn to the needles associated with said portion of said devices.

11. In a knitting machine, yarn-feeding means, movable needles, a stitch cam and movable instruments against which stitches are drawn in operative relation to said needles, whereby fabric of a certain length of stitches is normally made at all of said needles, in combination with means for feeding a splicing yarn to part of said needles, and means to change the relative time of movement between each needle of said part and the corresponding instruments only, to establish a different and uniform length of stitch at the spliced part of the fabric.

12. In a knitting machine, yarn-feeding means, movable needles, a stitch cam and movable instruments such as web-holders in operative relation to said needles, whereby fabric of a certain length of stitch is normally made at all of said needles, in combination with means for feeding a splicing yarn at predetermined times to a part only of said needles, and means acting when said splicing means is active to change at each needle of said part the relative time of movement between said needle and its adjacent instruments only, to establish a different and uniform length of stitch at the spliced part of the fabric.

13. In a knitting machine, yarn-feeding means, a series of independently movable needles, a stitch cam, independently movable web-holders and means to move said web-holders in operative relation to said needles, whereby fabric of a certain length of stitch is normally made at all of said needles, in combination with means for feeding a splicing yarn at predetermined times to a predetermined part of said series of needles, and means acting when said splicing means is active to shift the location of the relative movement of the web-holders with respect to said part of the needles, to cause a different length of stitch at said part of the needles.

14. In a knitting machine, yarn-feeding means, a series of independently movable needles, a stitch cam, independently movable web-holders in operative relation to said needles and a web-holder actuating cam whereby fabric of a certain length of stitch is

normally made at all of said needles, in combination with means acting on all of the web-holders at the needles taking the splicing yarn only, to cause a different and uniform length of stitch at the spliced part of the fabric.

15. In a knitting machine, a series of needles, knitting cams, yarn-feeding means, a series of web-holders, and a carrier for said web-holders, actuating means for said web-holders, a splicing yarn-guide, and means relatively fixed with respect to said carrier for actuating said splicing yarn guide, in combination with means acting upon all of the web-holders in a certain part of said carrier only to change their relation to the needles supplied with splicing yarn, whereby to uniformly slacken the stitches made by the needles so supplied.

16. In a knitting machine, needles, web-holders, needle cams, and means to alter the position of all of said web-holders with respect to the needle cams, combination with means to move a continuous part of the series of the web-holders with respect to the needles to a variable and adjustable extent to locally vary the length of the needle loops or stitches at said needles.

17. In a stocking knitting machine, a needle cylinder, independently movable needles having long and short butts therein, means including a vertically fixed knitting cam to cooperate with said needles to produce a stocking, said means cooperating with the short butt needles to produce the back of the leg, heel, sole and toe thereof, means to determine the length of the stitches, and means to independently vary the length of the stitches upon a continuous series of the needles, including the short butt needles and some of the adjacent long butt needles.

18. In a knitting machine, needle and cam carriers, independently movable needles and cams therefor in said carriers respectively, independently movable instruments cooperating with the needles at the verge of the needle carrier, means to rotate one of said carriers with respect to the other, a pattern surface and means to advance said pattern surface at predetermined times, in combination with a connection from said pattern surface for altering the position of the needle carrier and all of the said instruments with respect to the cam carrier to change the length of the stitch, means for moving each instrument of a continuous part of said independently movable instruments with respect to the needles to locally change the stitch length and a connection from said pattern surface to operate said means.

19. In a knitting machine, needle and cam carriers, independently movable needles and cams therefor in said carriers respec-

tively, independently movable web-holders having knocking-over portions coöperating with the needle cams at the verge of the needle carrier, means to advance and retract
 5 said web-holders, means to rotate one of said carriers with respect to the other, a pattern surface, and means to advance said pattern surface at predetermined times, in
 10 combination with a connection from said pattern surface for altering the position of the needle carrier and said web-holders with respect to the cam carrier, a supplemental cam for positioning some of said web-holders with respect to the needles and a longi-
 15 tudinally movable bar coöperating with said pattern surface at one end and said supplemental cam at its other end.

20. In a knitting machine, a knitting head comprising a vertically fixed cam ring, a
 20 needle cylinder and independent needles in said cylinder, means on said needle cylinder to determine a knocking-over line with respect to said cams, comprising a hollow tubular column concentric with said needle
 25 cylinder, a bearing in the frame of the machine for the upper end of said column, a bearing in the frame of the machine for the lower end of said column, means acting at predetermined times to elevate said column,
 30 and means coacting with said column to cause it to be elevated upon its manual rotation.

21. In a knitting machine a knitting head comprising a vertically fixed cam ring, a
 35 needle cylinder and independent needles in said cylinder, means on said cylinder to determine a knocking-over line with respect to said needles, and means to change the vertical position of the needle cylinder and
 40 knocking-over line with respect to said cam ring comprising a hollow tubular column of greater diameter than said needle cylinder, a bearing in the frame of the machine for the upper end of said column, a bearing in
 45 the frame of the machine for the lower end of said column, and coacting means on said column and said bearing comprising an ad-

justable plunger on one of said elements and a cam lug on the other, whereby said column may be turned to cause it to be elevated by
 50 said cam lug.

22. In a knitting machine, a vertically movable needle cylinder, independent needles therein and means to rotate said needle cylinder with respect to a fixed cam ring, a
 55 support for said needle cylinder and means to vertically adjust said support, in combination with needle cams for contact with needles in said cylinder having upward facing slopes, and downward facing slopes at a
 60 sharper angle than said upward facing slopes.

23. In a knitting machine, the combination of needles, web-holders, a cam-device
 65 for actuating said web-holders, and means to cause said cam device to operate some of said web-holders to a normal extent at a relatively earlier time than others.

24. In a knitting machine, a web-holder actuating cam device, web-holders in series
 70 having differentiated actuating portions, and means to cause said cam device to move said series of web-holders operatively through the same distances at different relative
 75 times.

25. In an independent needle knitting machine, the combination of needles and web-holders with means for altering the
 80 stitch-length at all of the needles, means for changing the relative times of actuation of the needles and web-holders to alter the stitch length independently at a part only of said needles, means for feeding a splicing
 85 yarn to said part of said needles, and a pattern device for controlling the times of operation of each of said means.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT W. SCOTT.

Witnesses:

WM. J. HAGERTY,
 HELEN M. SWEENEY.