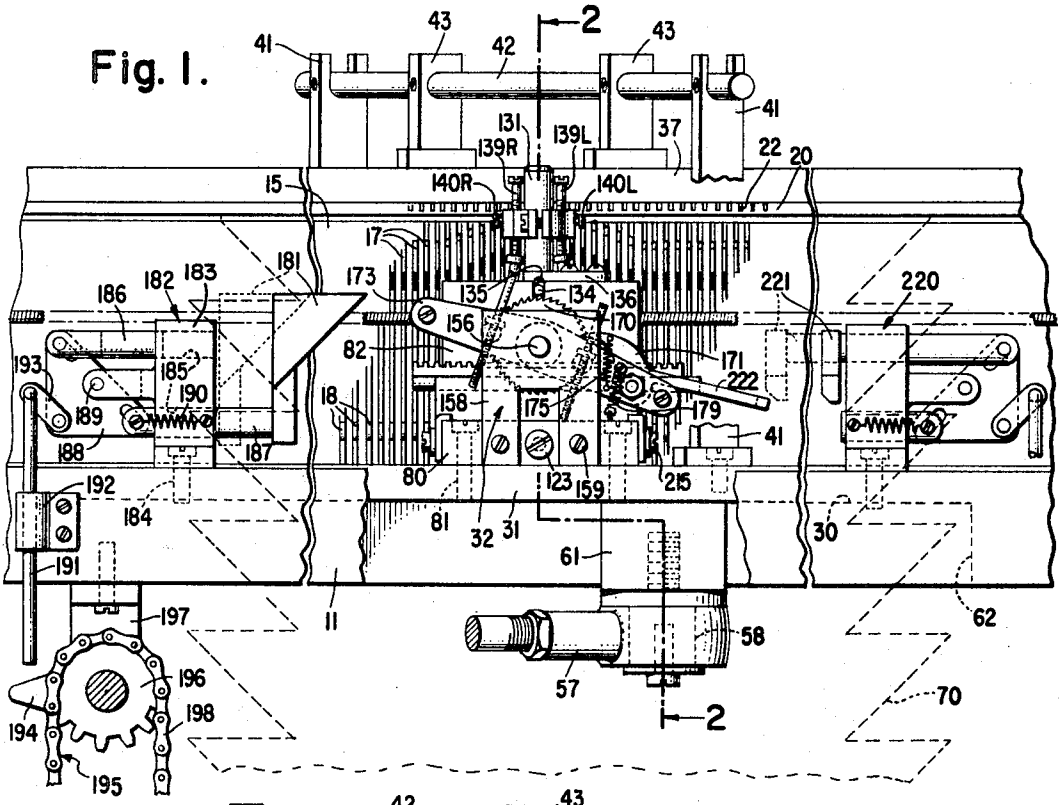
June 18, 1968 S. MISHCON 3,388,563

AUTOMATIC CAM SECTION FOR KNITTING MACHINES

Filed June 1, 1965 2 Sheets-Sheet 1

Fig. 1.



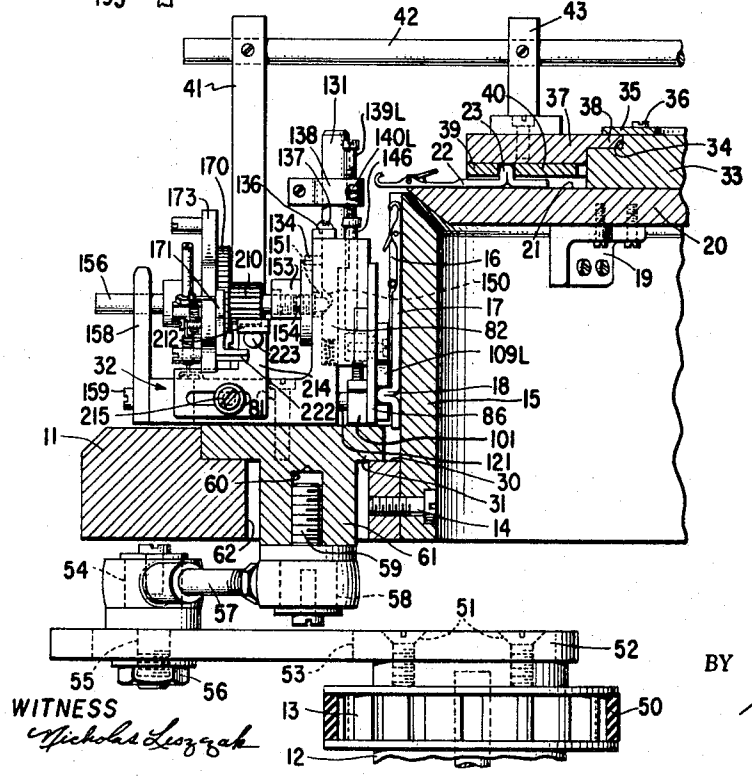


Fig. 2.

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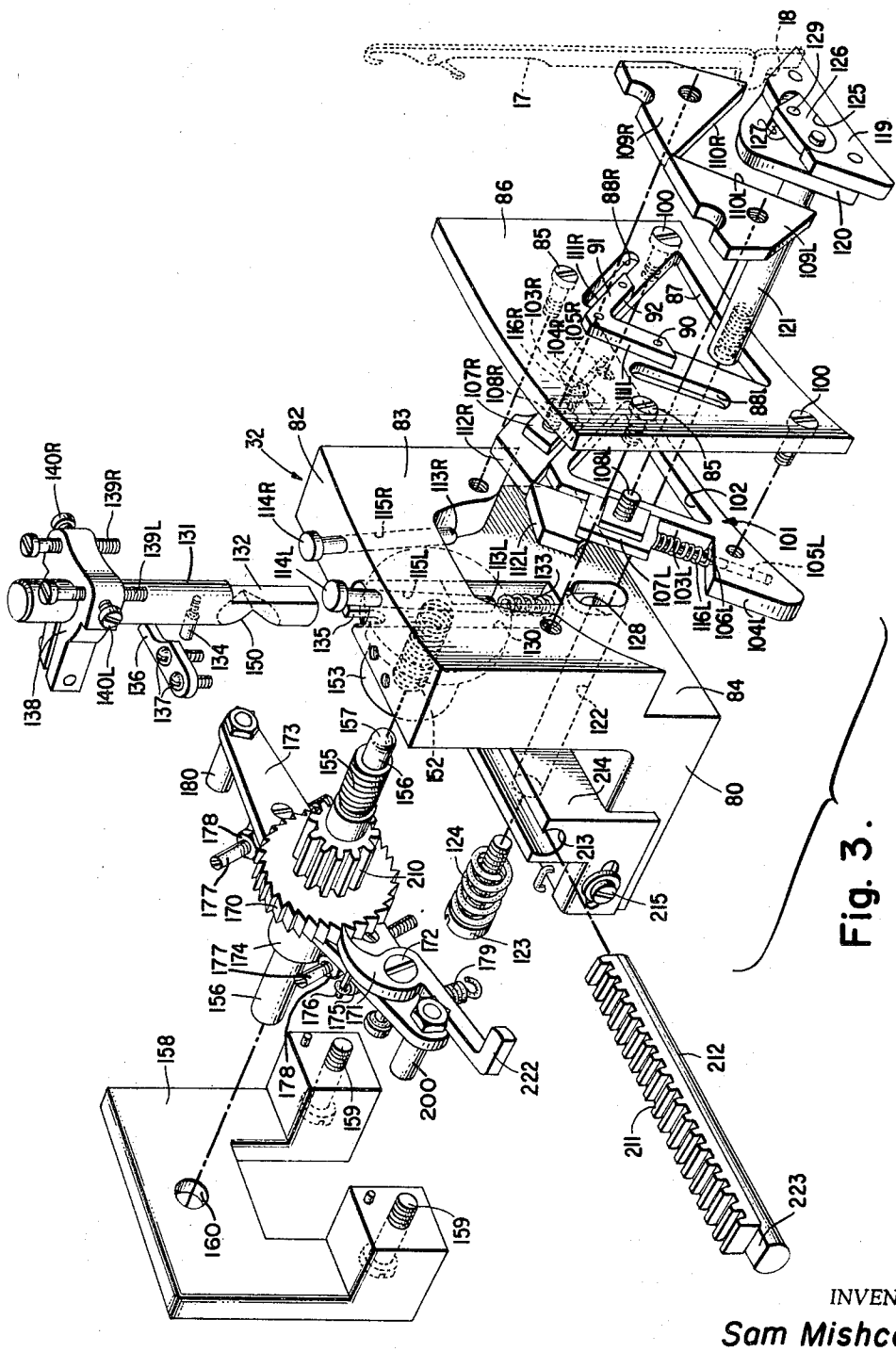


Fig. 3.

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United States Patent Office 3,388,563 Patented June 18, 1968

3,388,563

AUTOMATIC CAM SECTION FOR KNITTING MACHINES

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Filed June 1, 1965, Ser. No. 460,085
7 Claims. (Cl. 66—27)

ABSTRACT OF THE DISCLOSURE

An oscillatory circular knitting machine for making a simulated full fashioned article such as a shirt collar is diclosed. The needle cylinder of the machine is held stationary, and an adjustable cam block is oscillated relative to such cylinder. The cam block is so designed that after a predetermined number of courses during the knitting of the article, the stitch cam of the cam block gets indexed to a new position. Then, after a second predetermined number of courses of the article, the stitch cam is indexed again. This is repeated so that successively tighter and tighter (or looser and looser, as the case may be) courses are discretely provided in the article.

This invention relates to knitting machines of the type having independent knitting needles, and more particularly to a novel needle camming mechanism for such knitting machines.

It is an object of this invention to provide a needle camming arrangement for an independent needle knitting machine in which the effective position of the needle cams may be regulated in an automatic fashion during operation of the knitting machine in order to influence an automatic variation in the character of the resulting knitted web.

Using this invention it is possible to provide a needle camming section for an independent needle knitting machine in which the effective position of the needle cams may be regulated in an automatic fashion during operation of the knitting machine either gradually between a plurality of successive courses of knitting or abruptly between selected courses of knitting in accordance with a preselected pattern.

A further object of this invention is to provide an oscillating circular knitting machine with a cam section of the above character for automatically varying the length of the resulting knit stitches so as to produce shaped fabric panels which simulate full fashioned panels.

With the above and additional objects and advantages in view, as will hereinafter appear, this invention comprises the devices, combinations, and arrangements of parts hereinafter described and illustrated in the accompanying drawings of a preferred embodiment in which:

FIG. 1 represents a side elevational view of a portion of a knitting machine having the automatic cam section of this invention applied thereto,

FIG. 2 is an enlarged cross sectional view of the knitting machine of FIG. 1 taken substantially along line 2—2 thereof, and

FIG. 3 is an exploded perspective view of the automatic cam section.

In the drawings this invention is illustrated as applied to the cylinder needle cam means of an oscillating circular cylinder and dial knitting machine. As will be apparent, however from an understanding of this preferred embodiment, the automatic cam section of this invention may readily be applied to a flat bed knitting machine or to a circular knitting machine which is rotated continuously in one direction.

The knitting machine to which this invention is illustrated as applied in the drawings is provided with a stationary frame including an outer frame ring **11** illustrated in FIGS. 1 and 2, and a bearing column **12** illustrated in FIG. 2 in which a drive sprocket **13** is journaled. Secured to the outer frame ring **11** as by bolts **14** is a needle cylinder **15** formed externally with parallel needle slots **16** each slot slidably accommodating a latch knitting needle **17** formed with an outwardly protruding butt **18**. Attached to the needle cylinder **15** by spaced angle brackets **19** is a needle dial **20** formed with radial needle slots **21** each slot accommodating a latch knitting needle **22** formed with an upwardly protruding butt **23**.

For imparting endwise movement to the knitting needles, the outer frame ring **11** is formed with an annular recess **30** in which a cam retaining ring **31** is journaled for oscillatory motion. At spaced points about the needle cylinder, the cam retaining ring **31** carries section blocks indicated generally at **32** one section block between each spaced pair of brackets **19**. The section blocks **32** carry the automatically variable needle cams of this invention as will be described in detail hereinbelow and upon oscillation of the cam retaining ring **31**, the cams on each section block will influence the endwise position of a group of the cylinder needles between a respective pair of the brackets **19**.

Carried on the dial **20** is a cam race ring **33** formed with an annular raceway **34** covered by a gib ring **35** secured by screws **36** to the race ring. A dial cam ring **37** which is formed with an annular bearing rib **38** journaled in the raceway **34** carries cams **39** and **40** for influencing the endwise position of the dial cams. The cam retaining ring **31** and the dial cam ring **37** are interconnected for oscillation in unison by means of a pair of upstanding poses **41** secured on diametrically opposite sides of the cam retaining ring, a crossbar **42** secured in the upstanding posts **41**, and a pair of upstanding posts **43** fastened on the crossbar **42** and secured to the dial cam ring.

For imparting oscillatory motion to the cam retaining ring **31**, the sprocket wheel **13** which may be rotated by a belt **50** from a source of power such as an electric motor or the like, has affixed thereto as by screws **51** a crank arm **52** formed with a radial slot **53**. A shouldered crank pin **54** formed with a threaded stud **55** may be secured in selected position along the slot **53** by means of a nut **56** on the threaded stud **55**. A connecting rod **57** which embraces the crank pin **54** also embraces a shouldered pivot pin **58** which is formed with a stud **59** threaded by engaging a tapped hole **60** formed in the underside of a boss **61** depending from the cam retaining ring **31**. The boss **61** is accommodated in an arcuate clearance slot **62** in the outer frame ring **11** of the knitting machine.

Upon operation of the drive means, the cam retaining ring **31** and dial cam ring **37** will thus be oscillated carrying the section block **32** and the dial cams **39** and **40** back and fourth relatively to the cylinder and dial needles **17** and **22** in order to reciprocate the needles. A yarn stand as well as yarn carrier means which may be supported for oscillation with the cam rings **31** and **37** have been omitted from the drawings in the interest of clarity. It will be understood, however, that any conventional yarn carrier means including provision for periodically introducing a separating yarn may be used. Similarly a conventional web take-up device which may be utilized to draw the knitted strips from the needles has not been illustrated. In dashed lines in FIG. 1, however, is illustrated the general outline of one possible configuration of a knitted strip **70** which may be produced using the automatic cam means of this invention. It will be appreciated that one knitted strip such as **70** may be produced between each adjacent pair of angle blocks **19** and that a plurality of such knitted strips may be produced simultaneously about the cir-

cular machine with the character and configuration of each strip depending upon the cam arrangement for the corresponding group of knitting needles.

With particular reference to FIG. 3, the construction of the section block **32** of this invention will now be described.

The section block comprises an angle support bracket including a base limb **80** adapted to be secured by fastening screws **81** on the cam retaining ring **31** and an upstanding limb **82**. The upper portion of the exposed face **83** of the upstanding support bracket limb **82** is formed with a convex curvature corresponding to the curvature of the needle cylinder, while the lower portion of the exposed face is formed with a recessed seat **84** of generally triangular configuration. Fixed on the exposed face **83** of the support bracket limb **82** by screws **85** is a plate **86** having corresponding convex curvature. The plate **86** depends over and covers the recessed seat **84** and is formed opposite the recessed seat **84** with a right equilateral triangular opening **87** flanked at each side by symmetrically arranged elongated slots **88L** and **88R** parallel one with each side of the triangular opening **87**. Secured as by pins **90** to the plate **86** above the apex of the triangular opening **87** is an inverted V-shaped needle cam element **91**, the under surface **92** of which operates as a cushion cam for the needle butts during the rise of the cylinder needles and to impart an initial downward or drawing motion to the needles after the rise.

Since the cam means of the section block **32** is adapted, in the embodiment illustrated in the accompanying drawings, for use with an oscillating machine, the cams in order to cooperate with the needles in each direction of oscillation, are arranged symmetrically about the vertical centerline of the section block. The adjustable cam arrangement at the lefthand side of the section block as viewed in FIG. 3 will be denoted by reference characters with the suffix L and the cam arrangement symmetrical thereto on the righthand side will be denoted on the drawings by reference characters with the suffix R.

Disposed within the recess **84** in the support bracket limb **82** and secured behind the plate **86** by screws **100** is a guide frame **101** formed with a right equilateral triangular opening **102** congruent to the opening **87** in the plate **86**. The guide frame **101** is formed with inclined guide surfaces **103L** and **103R** parallel one with each side of the triangular opening **102** with each guide surface **103L** and **103R** terminating at the bottom of the guide frame in a projecting abutment lug **104L** and **104R**. Each of the abutment lugs **104L** and **104R** is formed with a guide bore **105L** and **105R** parallel to the guide surface and slidably accommodating a rod **106L** and **106R** projecting from a slide block **107L** and **107R** which engages the guide surface **103L** and **103R**. The slide blocks **107L** and **107R** each carry a threaded stud **108L** and **108R** projecting through the elongated slots **88L** and **88R** in the plate **86** and each threadedly engaging a draw cam **109L** and **109R** with a needle engaging cam surface **110L** and **110R** which contacts an outer guide surface **111L** and **111R** of the cushion cam **91**.

The slide blocks **107L** and **107R** are each formed with an enlarged slabbed head **112L** and **112R** which is engaged by the rounded lower extremity **113L** and **113R** of a slide pin **114L** and **114R** constrained in a bore **115L** and **115R** in the upstanding limb **82** of the support bracket. Constrained on the rods **106L** and **106R** between the abutment lugs **104L** and **104R** and the slide blocks **107L** and **107R** are coil springs **116L** and **116R** urging the draw cams upwardly. The coil springs however may be overcome and the draw cams shifted downwardly by depression of the slide pins **114L** and **114R**.

The cushion cam **91** and the draw cams **109L** and **109R** cooperate with a needle raise cam **119** which is preferably trapezoidal in shape and is secured to a positioning block **120** accommodated snugly within the triangular apertures **87** and **102** of the plate **86** and the guide frame **101**, respectively. The positioning block is formed with a cylindrical rod **121** disposed within a bore **122** in the base limb **80** of the angle support bracket and resiliently constrained therein by a headed screw **123** threaded into the free extremity of the rod **122** and accommodating a coil spring **124** between the head of the screw **123** and the base limb **80** of the bracket. The raise cam **119** is formed with a recess **125** at the top accommodating a pivoted swing cam **126** therein.

The positioning block **120** is formed with a clearance slot **127** and the upstanding support bracket limb **82** with a clearance slot **128** to accommodate a swing cam operating pin **129** which may be influenced by conventional means to turn the swing cam upward into a position to raise the needles **17** into the knit position or to lower the swing cam into the position illustrated in FIG. 3 in which the raise cam **120** will elevate the needles **17** into tuck position.

The upstanding bracket limb **82** is formed with a vertical guide bore **130** slidably accommodating a cylindrical slide rod **131** which may be slabbed as at **132** to avoid the seat **84**. A coil spring **133** arranged at the bottom of the guide bore **130** bears against and biases the slide rod **131** upwardly and a stop provided by a pin **134** extending transversely from the slide rod and working in a slot **135** through the sidewall of the guide bore **131** against a stop block **136** secured atop the bracket by screws **137** provides an upper limit to motion of the slide rod **131** in response to the force of the spring **133**. The pin **134** also prevents turning movement of the slide rod **131**. Clamped to the slide rod **131** above the bracket is a split collar **138** through which screws **139L** and **139R** are threaded each in alignment with one of the slide pins **114L** and **114R**. The screws **139L** and **139R** may be locked in selected position in the split collar **138** by means of set screws **140L** and **140R**.

The slide rod **131** is formed with a deep V notch **150** which is arranged in the guide bore **130** opposite a clearance opening **151** through the upstanding limb **82** of the support bracket. A threaded bore **152** formed in a collar **153** secured to the upstanding limb **82** by screws **154** is aligned with the clearance opening **151** and accommodates a threaded portion **155** of a shaft **156** of which the rounded free extremity **157** extends through the clearance opening **151** and into engagement with the V notch **150** in the slide rod **131**. A standard **158** secured by screws **159** to the base **80** of the bracket is formed with a bearing aperture **160** supporting the shaft **156**.

Preferably as illustrated in FIG. 2 the rounded free extremity **157** of the shaft abuts the lowermost inclined wall of the V notch **150** and serves to provide a micrometric adjustment of the vertical position of the slide rod **131** in response to the bias of the coil spring **133**. Turning of the shaft **156** in a clockwise direction as viewed in FIG. 3 will thus cause the shaft extremity **157** to withdraw from the guide bore **130** allowing the slide rod **131** and the stitch cams **109L** and **109R** to rise while turning of the shaft **156** in a counterclockwise direction as viewed in FIG. 3 will force the slide rod **131** and the stitch cams **109L** and **109R** downwardly.

It will be appreciated that the draw of the needles, i.e. the distance which the needle is withdrawn beyond the knitting line constitutes an important factor in the density of the resulting knitted web. As the stitch cams **109L** and **109R** are shifted downwardly, therefore, the density of the resulting knitted web will decrease and as the stitch cams are raised the density will be increased. In the drawings two different means are illustrated for imparting turning movement to the shaft **156** for shifting the position of the stich cams; one for imparting successive small movements of turning movement so as to effect a gradual change in the density of the knitted web, and the other for imparting a rapid turning movement to the shaft.

For imparting successive small increments of turning movement to the shaft **156** to effect a gradual change

of density of the knitted web, a ratchet wheel **170** is made fast to the shaft **156** of which the ratchet teeth are engaged by a pawl **171** pivoted as at **172** on a lever **173** freely journaled on the shaft **156** between the ratchet wheel and a collar **174** on the shaft. A coil spring **175** acting between a pin **176** projecting from the pawl **171** and the lever **173** biases the pawl into engagement with the ratchet wheel. A pair of stop screws **177** threaded in brackets **178** on the lever **173** one at each side of the shaft **173** abut the base limb **80** of the angle support bracket to limit turning movement of the lever **173** and a coil spring **179** acting between the lever **173** and the base limb **80** of the angle support bracket biases the lever **173** into the position illustrated in FIG. 1.

A stud **180** carried by the lever **173** at the opposite side from the pawl **171** is therefore normally biased into an elevated position by the coil spring **179** and during oscillation of the section block **32** may be engaged and depressed by an inclined cam block **181** carried by a conventional cannon indicated generally at **182** carried on the frame ring **11**.

Any conventional form of cannon **182** may be employed, as for instance, those regularly used to influence stripping devices into and out of operation in circular knitting machines. The essential elements of the cannon **182** include a support frame **183** secured by screws **184** to the frame ring **11** and formed with spaced guide bores **185** for a pair of plungers **186** and **187**. The plungers **186** and **187** are each pivotally connected to an operating lever **188** fulcrumed at **189** on the support frame **183** and a coil spring **190** acting between the operating lever **188** and the support frame **183** biases the plunger **187** to which the cam block **181** is secured into an extended position as illustrated in FIG. 1. A rod **191** slidable in a bushing **192** carried on the frame ring **11** is connected by a link **193** to the operating lever **188** and depends into the path of high links **194** on a pattern chain **195** as the chain passes over a sprocket **196** journaled in a bracket **197** secured beneath the frame ring **11**. The rod **191** is positioned by the bushing **192** out of the path of low links **198** of the pattern chain and therefore indexing of the pattern chain provides for control of the cannon **182**; the cam block **181** being positioned by the spring **190** into effective position in the path of motion of the stud **180** when a low link **198** is disposed opposite the rod **191** and the cam block being retracted whenever a high link **194** on the pattern cam is indexed into a position engaging the rod **191**.

The pattern chain may be indexed by appropriate connection (not shown) with the drive mechanism for the knitting machine as is conventional in the art.

While the cam block **181** occupies an effective position as illustrated in FIG. 1, the stud **180** by engaging the cam block during each oscillation of the section block **32** will impart an increment of turning movement to the lever **173** and thus to the pawl **171** and ratchet wheel **170**. The shaft **156** will thus be indexed gradually so as to impart a gradual shift to the stitch cams **109L** and R one increment of shift during each complete oscillation of the section block **32** thus changing the density of the knitted web on alternate courses of knitting.

The lever **173** may also be provided with a second stud **200** at the opposite side from the stud **180** and with a second cannon (not shown) with a cam block effective to impart an increment of movement to the lever **173** at the opposite extremity of the stroke of oscillation of the section block **32** so that the fabric density may be influenced between each course of knitting. It will be appreciated that by selection of the arrangement of high and low links in the pattern chain, the change in fabric density may be caused to occur in a uniform manner or may be made to occur periodically as desired.

The ratchet wheel **170** and associated pawl **171** provide for a gradual fabric density change only in one direction, i.e., in that direction toward a higher fabric density. It is within the scope of this invention however to provide on the shaft **156** a second ratchet wheel and pawl arrangement similar to the ratchet wheel **170** but with teeth inclined in the opposite direction and with an appropriate cannon device **182** for influencing gradual fabric density changes in either direction. When two such sets of ratchets and pawls are employed, the inactive pawl must be released during operation of the active pawl, but since such pawl release is also required when the rapid turning movement of the shaft **156** is effected, as will now be described, a pawl release similar to that presently to be described may be used when two sets of pawls are employed.

For imparting rapid change of position to the stitch cams **109L** and R, a pinion **210** is made fast to the shaft **156** and arranged in mesh with a rack **211** formed on a plunger **212** slidable in a guide slot **213** formed in a block **214** held by fastening screws **215** on the base limb **80** of the angle support bracket.

Referring to FIG. 1, **220** indicates a cannon similar in construction and operation to the cannon **182** described above except that it carries a different cam block **221**. The cam block **221** is carried by the cannon **220**, which cannon **220** is held stationary on the frame ring **11**; the cam block **221** is held normally in retracted and inoperative position, as illustrated in solid lines in FIG. 1, while a low link in the controlling pattern chain is disposed opposite the cannon control rod, and is adapted to shift the cannon control rod into operative position, as illustrated in dashed lines in FIG. 1 when under the influence of a high link in the pattern chain. The pawl **171** is formed with a tail **222** disposed for engagement by the cam block **221** when the cam block is shifted into operative position for the purpose of releasing the pawl **171** from the ratchet wheel **170**. The cam block **221** in operative position is also disposed in the path of motion of an abutment projection **223** formed on the rack plunger **212**. In other words, during the making of the cloth strip **70**, the cam section block **32** oscillates between the positions indicated by the cam blocks **181** and **221** (in full lines). Then, when the rack **211** is to be returned to its left hand side (looking at FIG. 1), the cannon **220** is actuated to place its cam block **221** to its position shown by dashed lines, whereby the subsequent rightward motion of the cam section block **32** first carries upward the tail **222** of the pawl **171**, and then the projection **223** on the plunger **212** against the extended cam block **221** that stands stationary to receive the oncoming cam section block **32**. The cam block **221** thus serves to release the pawl **171** and to cause relative movement between the rack **211** and the pinion **210** causing a rapid adjustment of the position of the stitch cams **109L** and **109R**.

Indicated at **70** in FIG. 1 is the general form of a knitted web which may be produced using the arrangement as illustrated in FIG. 1 in which the cannon **182** at one extreme of the stroke of oscillation of the section block **32** provides actuation for the ratchet and pawl for influencing a continuous gradual increase in fabric density from an initial value, and the cannon **220** at the opposite extreme of the stroke of oscillation of the section block **32** provides for the periodic actuation of the rack and pinion for rapid return of the fabric density to the initial value. The resulting knitted fabric web may be separated transversely at the points of rapid return to the initial value of fabric density providing ideally tapered collar sections which when applied about the neck of a garment, conform inherently to a desirable shape in which the collar lies smoothly about the neck and the collar points depend in a sharp angle from the neck opening rather than the wide spread blunt angle which is presented when a knit collar of uniform density is used.

Having set forth the nature of this invention, what

I claim herein is:

1. In combination with an independent needle circular knitting machine having a stationary frame, a needle supporting member with needles therein and a needle cam supporting member carried on said frame, drive means for imparting relative oscillatory motion to said needle support member and said needle cam supporting members, needle operating stitch cam means shiftably carried by said needle cam supporting member, mechanism carried by said needle cam supporting member for influencing in a direction lengthwise of said needles, the position of said needle operating cam means relatively to said needle cam supporting member, and means responsive to, and at a predetermined point in, the relative oscillatory motion of said needle and needle cam supporting means for operating said cam positioning mechanism.

2. In combination with an independent needle knitting machine having a stationary frame, a needle bed secured to said frame, a bank of knitting needles constrained in said bed, a needle cam supporting member carried on said frame, drive means for imparting reciprocatory motion to said needle cam supporting member transversely of said knitting needles, needle operating cam means shiftably sustained on said needle cam supporting member, cam shifting mechanism carried by said needle cam supporting member for incrementally influencing the position of said needle operating cam means in a direction lengthwise of said knitting needles, and abutment means carried by said frame and operatively engageable with said cam shifting mechanism at an extremity of reciprocation of said needle cam supporting means.

3. Mechanism for producing shaped fabric panels on an independent needle circular knitting machine having a needle bed, and a needle cam supporting member, comprising drive means for imparting oscillatory motion to said needle bed and said needle cam supporting member relatively to each other, a needle cam section block carried by said needle cam supporting member, at least one stitch cam shiftably supported on said section block, a stitch cam adjusting shaft threadedly engaging said section block, and means effective at the extremities of said oscillatory movement of said needle bed and needle cam supporting member relatively to each other for imparting increments of turning movement to said cam adjusting shaft.

4. Mechanism for producing shaped fabric panels on an independent needle circular knitting machine having a needle bed and a needle cam supporting member, comprising drive means for imparting oscillatory motion to said needle bed and said needle cam supporting member relatively to each other, a needle cam section block carried by said needle cam supporting member, at least one stitch cam shiftably supported on said section block, a stitch cam adjusting shaft threadedly engaging said section block, and means selectively effective at one extremity of said oscillatory movement of said needle bed and needle cam supporting member relatively to each other for imparting increments of turning movement to said cam adjusting shaft in one direction, and means selectively effective at the opposite extremity of said oscillatory movement for turning said cam adjusting shaft in the opposite direction.

5. An automatic cam section for an independent needle knitting machine comprising a section block, at least one needle operating cam slidably constrained on said section block for movement in a linear path thereon, a cam adjusting shaft threadedly engaging said section block on an axis transversely of said linear cam path, abutment means on said cam adjusting shaft for influencing the position of said needle operating cam along said linear path, an operating lever oscillatable on said cam adjusting shaft, and a ratchet and pawl connection between said operating lever and said cam adjusting shaft for imparting increments of turning movement in one direction to said cam adjusting shaft upon oscillation of said operating lever.

6. An automatic cam section for an independent needle knitting machine comprising a section block, at least one needle operating cam slidably constrained on said section block for movement in a linear path thereon between predetermined limits thereof, a cam adjusting shaft threadedly engaging said section block on an axis transversely of said linear cam path, abutment means on said cam adjusting shaft for influencing the position of said needle operating cam along said linear path, a pinion fast on said cam adjusting shaft and a rack slidably constrained in said section block and meshing with said pinion for imparting turning movement to said cam adjusting shaft to move said cam between said limits in a plurality of discrete steps in response to sliding movement of said rack.

7. An automatic cam section for an independent needle knitting machine comprising a section block, at least one needle operating cam slidably constrained on said section block for movement in a linear path thereon, a cam adjusting shaft threadedly engaging said section block on an axis transversely of said linear cam path, abutment means on said cam adjusting shaft for influencing the position of said needle operating cam along said linear path, an operating lever oscillatable on said cam adjusting shaft, and a ratchet and pawl connection between said operating lever and said cam adjusting shaft for imparting increments of turning movement in one direction to said cam adjusting shaft upon oscillation of said operating lever, a pinion fast on said cam adjusting shaft, a rack slidably constrained in said section block and meshing with said pinion for imparting turning movement in the opposite direction to said cam adjusting shaft in response to sliding movement of said rack, and means for disengaging said ratchet and pawl connection during sliding movement of said rack.

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