March 25, 1958 P. A. MAHLER 2,827,780

MARKING ATTACHMENT FOR CIRCULAR HOSIERY KNITTING MACHINES

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FIG. 1.

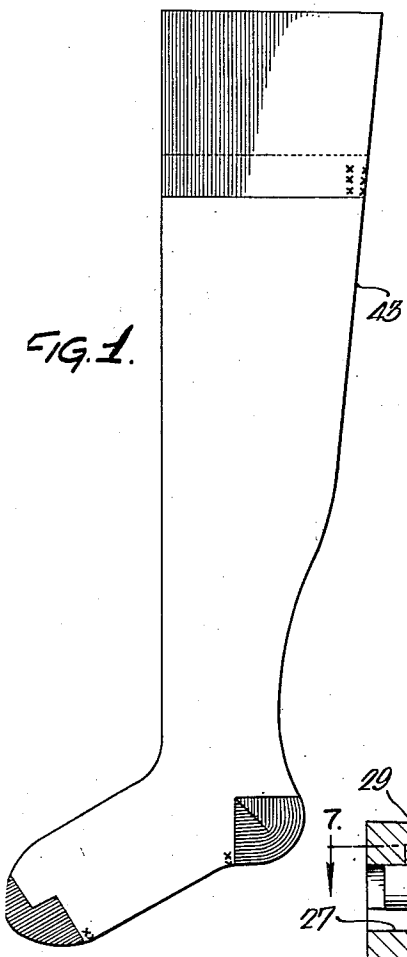


FIG. 2.

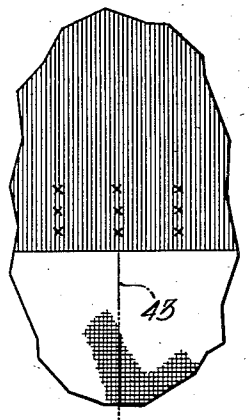


FIG. 3.

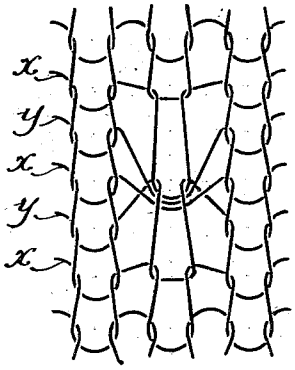


FIG. 6.

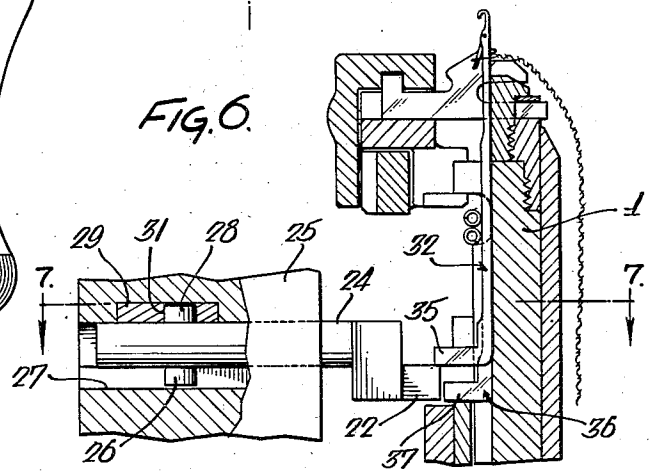
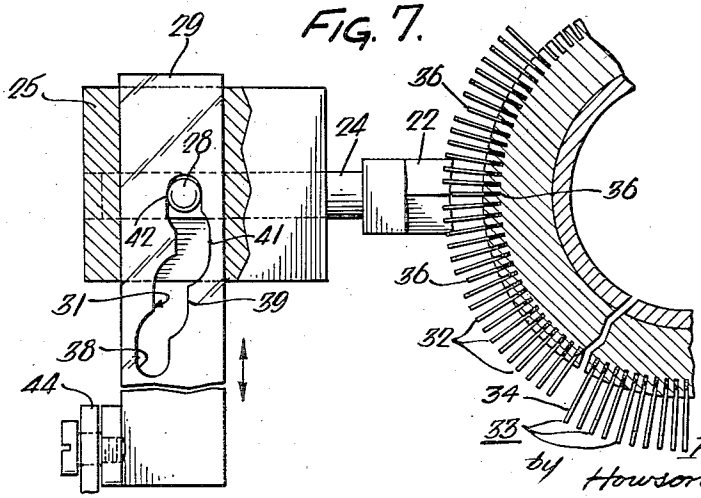


FIG. 7.



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FIG. 4.

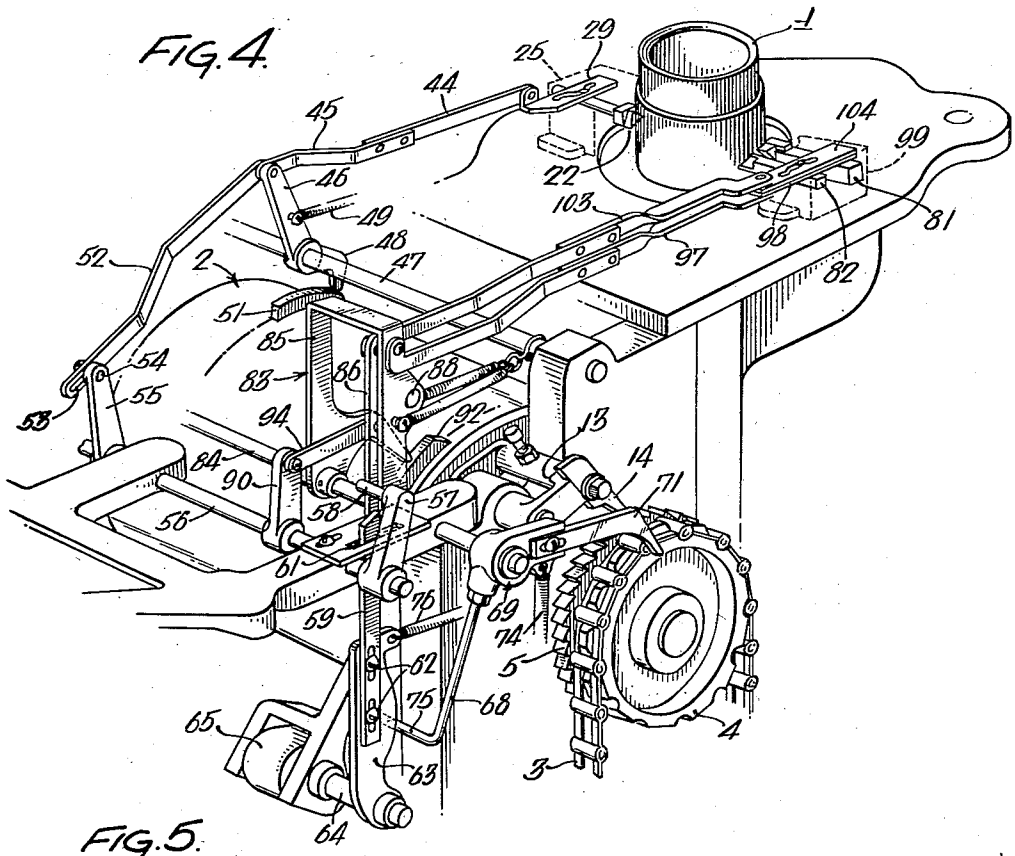
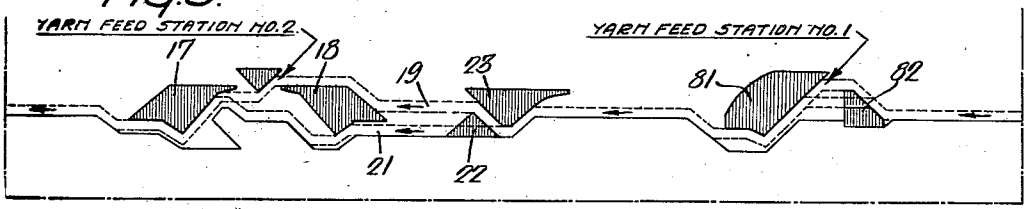


FIG. 5.



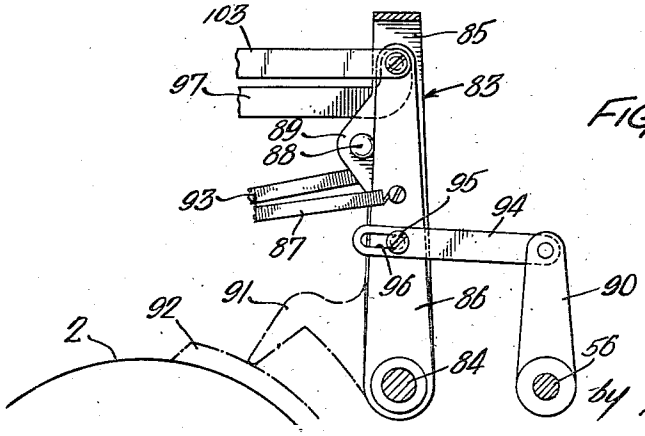


FIG. 13.

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FIG. 8.

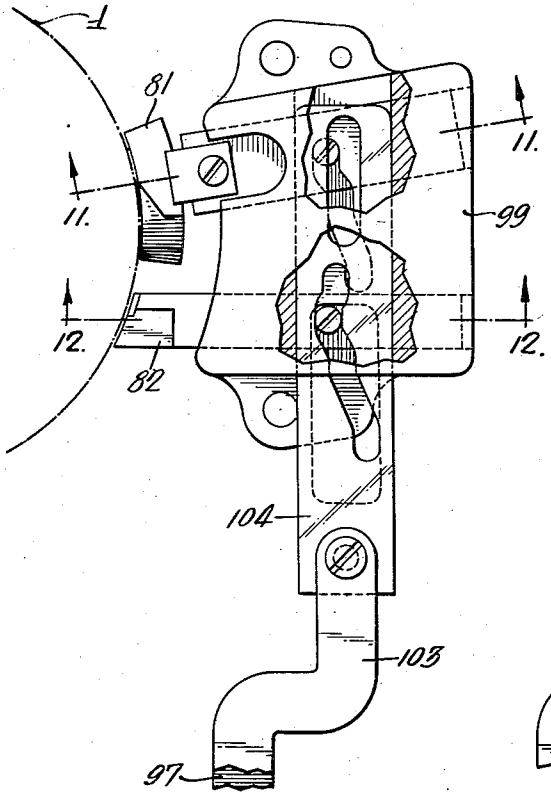


FIG. 9.

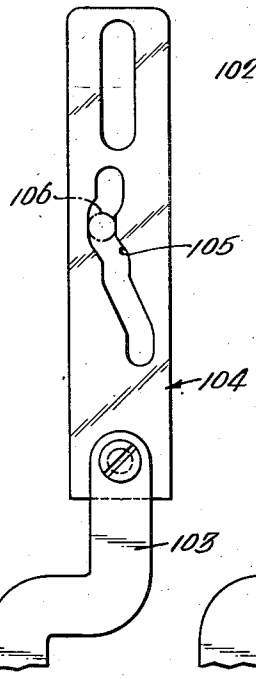
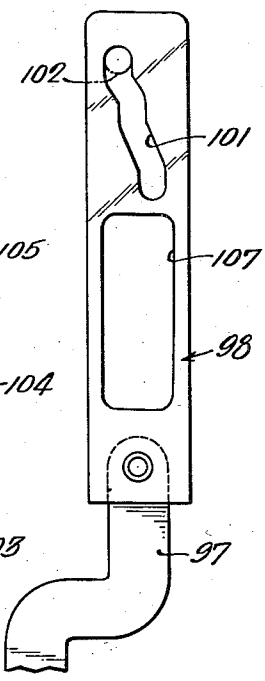


FIG. 10.



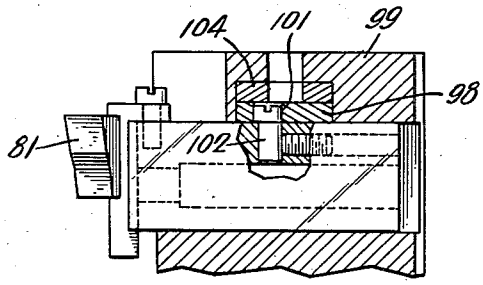


FIG. 11.

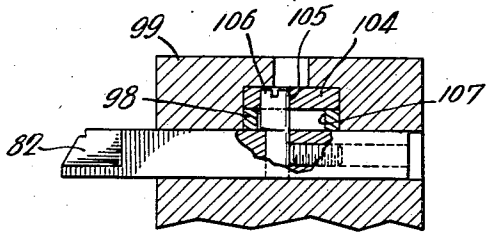


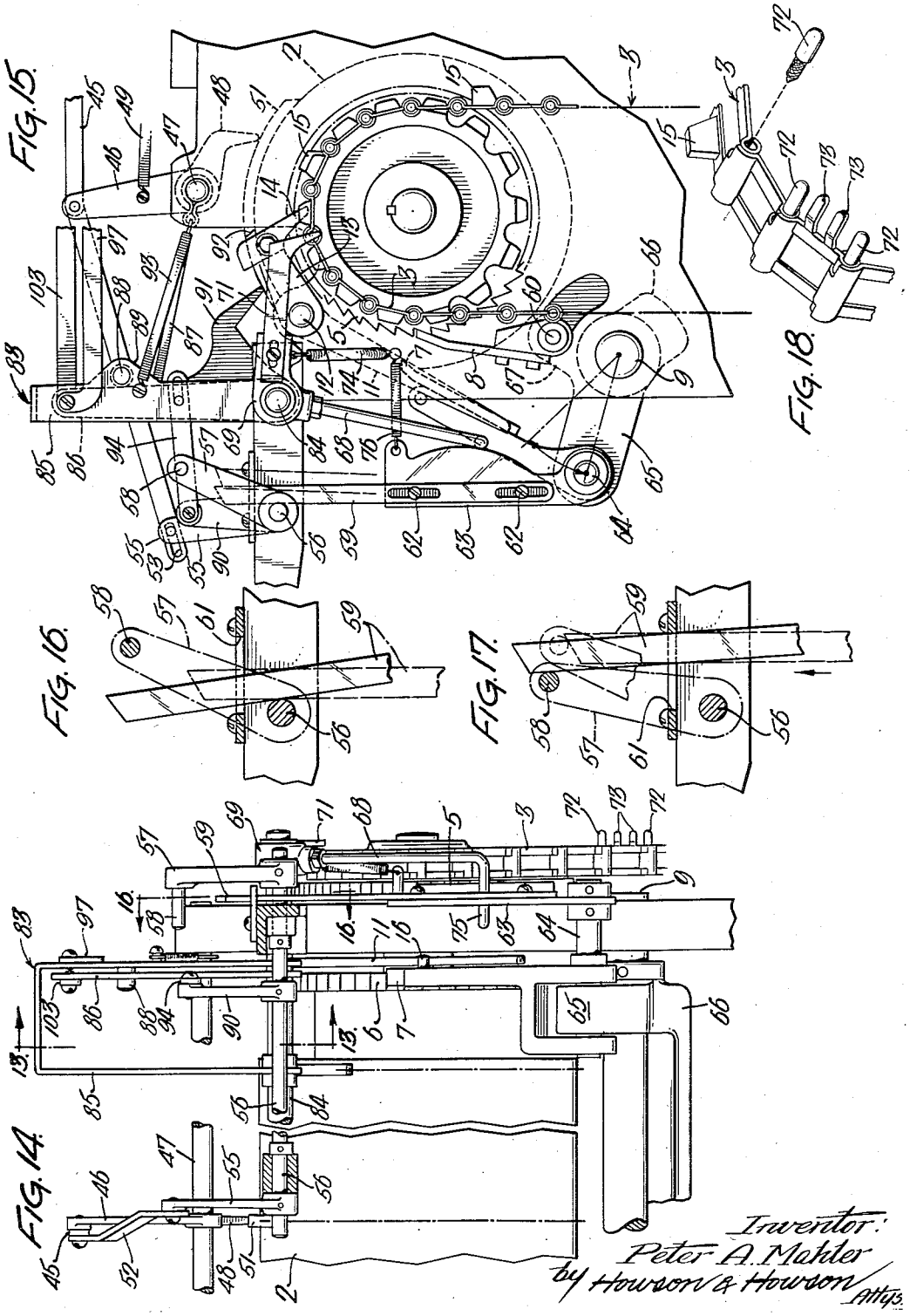
FIG. 12.

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Patented Mar. 25, 1958

2,827,780

MARKING ATTACHMENT FOR CIRCULAR HOSIERY KNITTING MACHINES

Peter A. Mahler, Philadelphia, Pa., assignor to Fidelity Machine Company, Inc., Philadelphia, Pa., a corporation of Pennsylvania

Application October 8, 1956, Serial No. 614,511

16 Claims. (Cl. 66—40)

This invention relates to an improvement in circular hosiery knitting machines and more particularly to an improved device for marking the knitted product by means of tuck stitches to indicate size or as a position guide or for other purpose.

Another and more specific object of the invention is to provide a marking device of the stated character which will utilize existing mechanisms and will be in the nature of an attachment leaving the said existing mechanisms substantially unmodified.

Still another object of the invention is to provide a marking device of the character set forth having adjustable means for regulating the length of the tuck stitch as required.

A further object of the invention is to provide a marking device adapted for use on circular knitting machines of the dual yarn feed type.

A still further object of the invention is to provide a marking attachment of the character described that may be adapted for use in machines having dual yarn feed provision and which may be used selectively in such machines by simple adjustment for either single or double feed operation.

The invention contemplates also that the marking device be of a character such that it may be applied in part to a single feed machine with provision for incorporation of the additional parts necessary for dual feed operation in event that the machine may subsequently be converted to dual feed operation.

Other objects will appear hereinafter.

The invention will be more readily understood by reference to the attached drawings in which:

Fig. 1 is a side view of a stocking having tuck stitch markings of the character to which the invention relates;

Fig. 2 is an enlarged fragmentary face view of a marked area of the stocking shown in Fig. 1;

Fig. 3 is a diagrammatic view showing the stitches of the stocking and the nature of the tuck stitches formed by the device of the invention in a stocking knit on a dual feed machine;

Fig. 4 is a more or less diagrammatic view in perspective of a machine equipped with mechanism in accordance with the invention;

Fig. 5 is a fragmentary development of the needle actuating cams of the machine including those constituting elements of the marking device of the invention;

Fig. 6 is an axial fragmentary sectional view of the needle cylinder illustrating one of the marking cams of the present invention in tuck stitch forming position with relation to the needles of the cylinder;

Fig. 7 is a sectional view on the line 7—7, Fig. 6;

Fig. 8 is a fragmentary plan view showing the details of the actuating means for the cams which constitute elements of the mechanism for actuating the needles at the second yarn feed station in a dual feed machine;

Fig. 9 is a plan view of the actuator for the tuck cam forming an element of the mechanism illustrated in Fig. 8;

Fig. 10 is a plan view of the actuator for the stitch cam forming an element of the mechanism shown in Fig. 8;

Fig. 11 is a sectional view on the line 11—11, Fig. 8;

Fig. 12 is a sectional view on the line 12—12, Fig. 8;

Fig. 13 is a fragmentary enlarged view showing in elevation the reverse side of certain of the parts illustrated in Fig. 4;

Fig. 14 is a rear elevational view as seen from the left hand side of the machine as illustrated in Fig. 4;

Fig. 15 is a fragmentary side elevational view of the mechanism illustrated in Fig. 4;

Fig. 16 is a sectional view on the line 16—16, Fig. 14;

Fig. 17 is a view similar to Fig. 16 showing the elements of mechanism therein illustrated in a different operative position, and

Fig. 18 is an exploded view in perspective of a section of the pattern chain.

With reference to the drawings, the numeral 1 indicates the cylinder of a circular knitting machine, the operations of which are determined by a pattern cylinder 2 under control of a pattern chain 3. The chain 3 is traversed in step-by-step or intermittent movement through the medium of a sprocket 4 and associated ratchet wheel 5 and by pawl mechanism hereinafter described, and this traverse movement of the chain is geared to the rotary movement of the cylinder 1 so that the chain advances in timed relation to the movement of the cylinder. In the present instance, it may be considered that a traverse movement of the chain occurs at each fourth revolution of the cylinder. It may be noted also that each traverse movement of the chain advances the latter to an extent corresponding to one-third of the length of one of the links and the functional aspect of this relationship will be hereinafter described. The rotary traverse movement of the drum 2 is intermittent and is effected through devices separate from the chain traversing means and includes an annular ratchet 6 on the drum and an associated pawl 7 shown in Figs. 14 and 15 which also show the pawl 8 which coacts with the ratchet wheel 5 to traverse the chain. The mode of operation in this portion of the device is essentially the same as that shown in United States Patent 2,422,568.

The pawls 7 and 8 are secured to a common rock shaft 9 which is geared to the cylinder drive mechanism so that the movements of the pattern chain and cylinder are relatively timed as described above. The pawl 7 is retractable from the ratchet 6 to an inoperative position by means of a lever arm 11 which is attached to a shaft 12, and this shaft carries a second lever arm 13 mounting a finger 14 which engages cams 15, 15 on the chain 3. When, as shown in Fig. 15, the finger 14 is not engaged by one of the high cams 15 of the chain, the shaft 12 will occupy a position wherein the arm 11 by engagement with a pin 16 on the pawl 7 will hold the pawl out of engagement with the ratchet 6. Under these conditions the rocking movement of the shaft 9 will have no effect upon the cam drum 2 so that while the pawl 8 intermittently traverses the pattern chain 3, the drum remains stationary. When, however, one of the high cams 15 engages the finger 14 and elevates the arm 13 to rock shaft 12, the arm 11 will be retracted and will permit the pawl 7 to move into operative engagement with the ratchet 6. During the periods wherein the chain cams 15 act in this manner to retract the arm 11, the rocking movements of the shaft 9 will effect an intermittent rotation of the cam drum 2 as well as of the chain 3. The mechanism insofar as described corresponds essentially in form and function to that disclosed in United States Patent 2,422,568.

In knitting a fabric on the machine described above, the action of the needles in the cylinder 1 is controlled by regulation stitch cams 17 and 18 (see Fig. 5) which

operate in conventional manner. Assuming that the cylinder is rotating in the direction indicated by the arrows in Fig. 5, it will be necessary in order to form a conventional tuck stitch to manipulate the needles so that they avoid the cam **18** which in normal knitting functions to elevate the needles to a position where the loop carried thereby clears the lower end of the depending latch. The normal path of the needles in knitting a plain fabric is indicated by the reference numeral **19**, it being noted that this path carries the needle against the inclined side of the path **18** which then functions to elevate the needle to the extent required for the loop to clear the latch. The needle following this path will then be directed downwardly at the inside of the cam **17** to cast the aforesaid loop and to form a new and intersecting loop from yarn bed to the needle while in the elevated position. A needle manipulated to avoid the cam **18** in accordance with the invention will follow a path indicated by the reference numeral **21** will not cast the original loop and will thereby form a composite loop which is not cast from the needle until a subsequent elevation of the needle by the cam **18** or its equivalent. In order to manipulate a needle to form a tuck stitch in accordance with the present invention, I provide a cam **22** which in plain knitting will direct the needles, previously depressed by a cam **23**, into the path **19** and which may be adjusted to a position clearing the butts of those selected needles which are to produce tuck stitches in the fabric.

The manner in which the cam **22** so acts is best illustrated in Figs. 6 and 7. This cam is mounted at the end of a rod **24** which is slidably supported in the frame **25** of the machine and which is held against angular displacement about its longitudinal axis by an intersecting pin **26** which projects at the underside of the bar into a guide slot **27** and which projects at the top of the bar, as indicated at **28**, into a cam slot **31** of a cam actuator **29**, said actuator, as shown in Figs. 6 and 7, being mounted for longitudinal adjustment in the frame **25**. By reason of the form of the slot **31**, longitudinal movements of the actuator **29** will effect a longitudinal adjustment of the rod **24** and a consequent adjustment of the cam **22** radially of the cylinder **1** and with respect to the butts of the needles carried in the latter.

As shown in Fig. 7, these needles are in two primary groups designated **32** and **33** respectively which differ as to butt length, the needles **33** having relatively long butts **34** as compared with the shorter butts **35** of the needles **32**. Interspersed with the needles **32** are the particular needles which produce the desired tuck stitches. These needles are identified in Fig. 7 by the reference numeral **36**. In the present instance they are three in number and are specifically located in the cylinder to produce the tuck stitches at desired points on the circumference of the stocking. These needles **36** are distinguished from the needles **32** and **33** by their exceptionally short butts **37**, as illustrated in Fig. 6. The cam **22** is adjustable between alternative positions in one of which it is completely retracted from all of the needles, so that it has no effect upon the knitting operation, and a second position in which it is inserted to a maximum extent for engagement with the butts of all of the needles including those of the needles **36**. In a third position, it is retracted from the fully inserted position to the intermediate position shown in Figs. 6 and 7 wherein as the cylinder rotates it will engage the butts of all the needles except those of the needles **36** and the latter needles as described above will then be permitted to follow the path **21** (see Fig. 5) and to produce the desired tuck stitches.

The manner in which the actuator **29** operates to adjust the cam **22** to the several positions described above is best illustrated in Fig. 7. The actuator **29** is adjustable longitudinally between the extreme position shown in the drawing and a position in which the pin end **28** occupies the opposite end **38** of the cam slot **31**. In this latter position, the cam **22** will be fully retracted to a position in which it is inactive with respect to any of the needles. As the actuator is moved from this position, the pin **28** will move into the offset section **39** of the slot and the cam will be advanced into a position for engagement with the relatively long butts of the needles **33**, this advance movement being effected while the shorter butt needles **32** are opposite the cam position. While in engagement with the needles **33**, a further or continued advance of the actuator will bring the pin **28** into the still further offset section **41** of the slot and will advance the cam into a fully inserted position in which it will lie in the path of the butts of the needles **32** and **36** as well as of the needles **33** so that when the cylinder rotates all of the needles, first depressed by the cam **23**, will be immediately again elevated by action of the cam **22** to follow the normal course **19** described above. In any particular course in which tuck stitches are desired, the cam, by a further movement of the actuator **29** bringing the pin **28** into the end section **42** of the slot **31**, will be again retracted but only to an extent clearing the butts of the needles **36** so that in that course of knitting, the needles **36** will not cast their loops and will produce tuck stitches in accordance with conventional principle.

In the present instance, three tuck stitches will be produced in a single course by action of the three needles **36**. In Figs. 1 and 2, tuck stitches indicated by the cross marks are shown in three series of three such stitches, each series occupying a different course. The location of the tuck stitch producing needles **36** in this case is such that the needle stitches of each series lies on a longitudinal line at the exact rear center of the stocking, this line being indicated by the reference numeral **43**. The six tuck stitches arranged in this manner may function in accordance with a pre-conceived code to indicate the size of the stocking and also as a guide for an operator folding or boarding the stocking to enable her to locate the fold or board edge accurately along the rear center line of the stocking.

It will be noted by reference to Fig. 1 that two additional rows of tuck stitches indicated by crosses are located at the termined end of the heel pocket and in advance of the toe pocket, and these tuck stitches may also constitute a guide for the operator in folding or boarding the stocking.

The cam **23** is a conventional needle depressing cam adjustable individually and having functions in addition to those with which the present invention is concerned. In the practice of the invention the cam **23** will be fully inserted when the cam **22** is in either the fully inserted or intermediate positions, and to this extent therefor and for considerations of the present invention may be considered fixed.

The manner in which the actuator **29** is operated is well illustrated in Fig. 4. The actuator is connected through links **44** and **45** to the upper end of an arm **46** of a bell crank lever mounted on a transverse shaft **47** in the frame of the machine. The other or lower end of this bell crank lever, constituted by an arm **48**, extends downwardly into cooperative relation with the pattern drum **2**. A spring **49** tends to retain the lever **46**, **48** in a position wherein the actuator **29** has been adjusted to bring the pin **28** into the terminal end **38** of the slot **31**. As previously indicated, in this position of the actuator **29** the cam **22** will be fully retracted and will be inoperative with respect to the needles. When, however, by reason of rotation of the pattern drum **2** a cam lug **51** on the drum is brought into engagement with the lower terminal end of the arm **48**, the lever will be rocked counterclockwise as viewed in the drawings so as to shift the actuator **29** against the tension of the spring **49** to a position in which the pin **28** will occupy the section **41** of the cam slot **31**. This movement of the actuator and the resulting movement of the cam **22** will be initiated while the needles **32** are opposite the cam **22** and will be continued after engagement of the needles **33** with the

cam so that as the needles 35 and 36 move into cam engaging position, the cam will occupy the extreme inserted position in which it operates on the butts of all of the needles. This does not affect the normal knitting operation but in effect conditions the cam 22 for subsequent adjustment into the tuck stitch forming position.

The actual adjustment of the cam 29 to move it from the conditioned to the tuck stitch forming position shown in Figs. 6 and 7 is effected by the pattern chain acting through a system of links and levers connected to the terminal end of a link 52 attached to the lever arm 46. The terminal end of this link 52 is slotted, as indicated at 53, and the slot receives a pin 54 on the upper end of an arm 55 attached to a rock shaft 56 in the frame. The slot and pin connection provides for lost motion between the link 52 and the arm 55 for a purpose hereinafter described. At its opposite end the shaft 56 carries a second arm 57 having a transversely extending pin 58 at its upper end. This pin is positioned for operative engagement by the upper bevelled end of a saber cam 59 which is guided in a slot 61 in the frame immediately below the pin 58 and whose lower end is adjustably secured at 62 to an arm 63, this arm being pivotally attached to a pin 64 which projects transversely from one arm 65 of a bell crank lever 66 secured to the rock shaft 9. The other end of this lever (not shown) is operatively connected to the cylinder drive mechanism for oscillation in timed relation with the cylinder rotation. The pin 64 also provides a pivotal mount for the drum pawl 7 so that in effect this pawl is mounted on the arm 65 of the bell crank 66. The pattern chain pawl 8 is similarly pivotally mounted on a pin 69 projecting transversely from another arm 67 of the bell crank 66. As the shaft 9 is rocked in timed relation with the cylinder the pawl 8 effects the intermittent traverse movement of the pattern chain 3, and the saber cam 59 is simultaneously vertically reciprocated in the slot 61.

Normally the arm 57 will occupy the position in which it is shown in Figs. 4 and 16, and in this position the pin 58 will lie out of the normal path of reciprocation of the cam 59, as illustrated in Fig. 16. In other words, the slot 61 is sufficiently long to permit the cam to reciprocate in a path clearing the pin 58. This normal path of reciprocation of the cam 59 is established by the action of one arm 68 of a bell crank 69, see Fig. 4. The other arm 71 of the lever 69 extends into operative position with respect to the chain 3. Actually, the arm 71 does not engage the chain itself, but its outer terminal end lies in the path of pins 72 and lugs 73 projecting transversely from a side of the chain, the pins 72 being secured in the hollow pintles of the chain and the lugs 73 in the present instance being integral frangible projections from the side of the chain links. A spring 74 tends to retain the arm 71 in a depressed position in the paths of the pins and lugs as the chain is traversed and in this depressed position, a transverse extension 75 of the arm 68 engages the curved confronting edge of the arm 63 and holds that arm in a retracted position against the pull of a spring 76 which tends to draw it to the right as viewed in Fig. 15. This position of the arm 63 corresponds to the positions of saber cam 59 shown in Fig. 16 in which as previously set forth the reciprocatory path of the cam lies at one side of the normal position of the pin 58 of the arm 57. Under these circumstances reciprocation of the cam 59 can have no effect upon the position of the arm 57.

When, however, the terminal end of the lever 71 is engaged by one of the pins 72 or a lug 73, the arm 71 will be elevated thereby retracting the arm 68 and its extension 75 and permitting the lever 63 to move to the right as viewed in Fig. 15 under the pull of the spring 76. The cam 59 will then assume the positions shown in Fig. 17 wherein upward movement of the cam will bring its bevelled upper end in camming engagement with the pin 58 as illustrated in Fig. 17 and will in its continued upward movement displace the arm 57 to the left and into the position shown in broken lines in Fig. 17. This displacement of the arm 57 rocks the shaft 56 and with it, the arm 55 to an extent such that the link 52 is moved sufficiently to retract the cam 29 to the tuck stitch forming position in which the cam 22 will occupy the intermediate position.

It will be noted that the pins 72 and lugs 73 are spaced relatively to each other to an extent corresponding to each traverse movement of the pattern chain and that the parts are so relatively arranged that each traverse movement is terminated in a position such that the terminal end of the lever 71 will be directly over one of the pins 72 or one of the lugs 73, assuming of course that the particular link then underlying the arm 71 carries such pin or lug. In the absence of a pin or lug, therefore, the arm 71 will retain its normal depressed position so that the formation of a tuck stitch is directly dependent upon the presence or absence of a pin 72 or lug 73 in a position to engage the arm 71 at the terminus of any individual traverse movement of the chain. It will be noted also that the lost motion connection between the arm 55 and link 52 provides for adjustment of the actuator 29 by the arm 46 independently of the arm 55.

It will be noted by reference more particularly to Fig. 15 that the adjustability of the saber cam 59 on the arm 63 provides for adjustment of the cam into positions wherein at the beginning of any working or upstroke of the cam, the upper bevelled end thereof is more or less distant from the pin 58. If at the initiation of the working stroke the inclined end of the cam is close to the pin, the shifting of the arm 57 will occur at the beginning of the working stroke and consequently, the dwell of the lever 57 in the displaced position shown in Fig. 17 will be relatively long, extending over a relatively great part of the reciprocatory movement of the cam. In this case, therefore, the dwell of the tuck cam 22 in the tuck stitch forming position will be correspondingly long, and will extend over a relatively long period of cylinder rotation. If, on the other hand, the bevelled upper end of the cam 59 lies relatively remote from or far below the pin 58 at the initiation of the working stroke of the cam, the actual displacement of the arm 57 by the cam will occur relatively late in the working stroke and the dwell of the arm 57 in displaced position will be relatively short in terms of the total reciprocatory movement of the cam. Similarly, in this instance, the dwell of the cam 22 in the tuck stitch forming position will be relatively short in relation to the rotary movement of the cylinder. One of the functional purposes of this device will be described below.

In adapting this tuck stitch forming device for dual feed operation, I may provide the additional needle cams shown to the right in Fig. 5, these cams being placed in angularly spaced relation with respect to the cams 17 and 18. The cam 81 is a conventional stitch cam designed to depress the needles moving in the direction indicated by the arrows subsequent to the feeding of the yarn to the needles at the indicated adjoining station so as to form the loops of the knitted fabric. The cam 81 corresponds essentially to the cam 17 previously described. The cam 82 is a clearing cam having the function of elevating the needles in advance of the stitch cam 81 to receive the yarn at the yarn feed station and to move the needle to a position sufficiently elevated that the previously applied loop or loops may clear the lower end of the latch for casting off by subsequent depression of the needle by cam 81. The cam 82 is formed, however, so that in an intermediate position of adjustment, corresponding to the intermediate position of the cam 22 previously described, the cam will have moved out of the path of the previously selected tuck stitch needles having the short butts 37, that is to say, the short butt needles 36 previously described. When, therefore, the cam 82 is in the fully inserted position, all of the

needles will be elevated for reception of yarn and to clear the carried loops with respect to the latch so that subsequent depression by the cam **81** will cast the loops in accordance with conventional process in producing a plain knit fabric. When the cam **82** occupies the intermediate position, the needles **36** will not be elevated to the extent that the contained loops clear the latches so that subsequent depression will not result in casting of the loops but in retention thereof by the needles with subsequent resulting formation of tuck stitches as well understood in the art.

As in the case of the tuck-stitch-forming cams previously described, provision is made for retracting the cams **81** and **82** entirely from the needle cylinders so that they are inoperative with respect to the needles. From this fully retracted position, the cams will be adjusted simultaneously and in accordance with the principles previously described to a fully inserted position in which all of the needles are fully elevated by the cam **82** and so that the loops will clear the latches. From this fully inserted position, provision is made for adjusting the cam **82** only to an intermediate position in which it is inoperative with respect to the needles **36** so that tuck stitches may be produced by those needles in accordance with the principle previously set forth.

The mechanism for accomplishing these adjustments of the cams consists in part of a compound lever indicated generally by the reference numeral **83**, this lever being pivotally mounted on a shaft **84** which also provides a pivotal support for the previously mentioned lever **69**. The lever **83** comprises two relatively movable parts of which one, designated by the reference numeral **85** is in the form of an inverted stirrup, the opposite ends of which are pivotally engaged with the shaft **84**. The second and relatively movable element of the lever consists of an arm **86** also pivotally supported on the shaft **84** and normally retained in alignment with the stirrup **85**, as shown in Fig. 13, by means of a spring **87** which draws the arm **86** against a pin **88** projecting from a lug **89** on the stirrup. The stirrup element **84** has a projecting arm **91** which extends in operative relation to the surface of the pattern drum **2**. When the arm **91** is engaged by a drum cam, such as the cam **92**, the lever **85** will be moved to the right as viewed in Fig. 13; and when the arm **91** leaves the cam **92**, the arm **85** will move to the left under the action of a spring **93**. When the element **85** is shifted by the cam **92**, the pin **88** acting on the element **86** will carry that element to the right with the element **85** so that the relative positions of the elements remain unchanged. The arm **86**, however, is free to move further to the right and away from the pin **88** against the pull of the spring **87** under circumstances described below.

The arm **86** is connected by a link **94** to an arm **90** on the shaft **56**. The connection of the link **94** with the arm **86** is by way of a pin **95** which passes through a slot **96** in the link thereby affording a certain lost motion between the arm **86** and the arm **90**. When the composite lever **85**, **86** is in the normal position, the arm **91** being free of any of the cams **92** of the drum **2**, the pin **95** will occupy the left hand end of the slot **96** as viewed in Fig. 13, so that the slot **96** in effect provides for the movement of the lever **85**, **86** by action of the drum cam **92** without affecting the position of the arm **90**.

The lever element **85** is connected by a link **97** with a cam actuator **98** of the general character of the actuator **29** previously described. This actuator takes the form of an elongated plate slidably mounted for longitudinal adjustment in a block **99** in the frame. The plate carries a cam slot **101** of the general character of the cam slot **31** of the previously described actuator **29**. By way in part of a pin **102** which projects into the slot **101**, the actuator **98** is operatively connected with the cam **81**, which cam is mounted in the frame in the same manner as the cam **22** previously described, and being adjustable in similar manner by the actuator **98** radially with respect to the needle cylinder.

The lever element **86** is operatively connected by a link **103** with a cam actuator **104** which is slidably supported in the block **99** immediately above the actuator **98** as shown in Figs. 11 and 12. The actuator **104** has a cam slot **105** corresponding substantially to the slot **31** of the actuator **29** previously described and this slot receives a pin **106** which provides an operative connection between the actuator **104** and the cam **82** previously described. It will be noted that the actuator **98** is apertured at **107** so as to afford passage therethrough for the pin **106** which from the cam groove **105** of the actuator **104**, extends downwardly through the aperture **107** of the actuator **98** and into the body of the cam **82** as shown in Fig. 12.

In the drawings, the lever **83** is shown retracted by action of the drum cam **92**, and the actuators **98** and **104** as shown in Figs. 8, 9 and 10, occupy corresponding positions resulting from this retraction of the lever. In these positions, the actuators have advanced the cams **81** and **82** to a fully inserted position in which they operate on all of the needles of the cylinder including the extra short butt needles **36**. The actuator **98** occupies an extreme position in which the pin **102** lies at the terminal end of the cam slot **101**; but the actuator **104** occupies an intermediate position in which an additional retraction of the actuator will result in a withdrawal of the cam **82** from the fully inserted to an intermediate position in which it operates on all of the needles of the cylinder with exception of the needles **36**. In this intermediate position, the cam is effective to prevent the casting of the loops from the needles **36** for the production of the desired tuck stitches. This adjustment of the actuator **104** from the position in which it is shown in Figs. 8 and 9 to a position wherein the cam **82** is moved to the intermediate position is effected by a movement of the lever **86** independently of its companion element **85** away from the pin **88** and against the pull of the spring **87** by rocking of the shaft **56** and resultant angular movement of the arm **95**. It will be noted that this rocking movement of the shaft **56** also effects a corresponding adjustment of the actuator **29** to move the cam **22** into the intermediate or tuck stitch forming position, so that in this respect the movements of the cams **82** and **22** are simultaneous. As previously described, the rocking movements of the shaft **56** occur as a result of the action of the saber cam **59** under control of the pattern chain **3** acting through the lever **69**.

Retraction of the cams **81** and **82** from their fully inserted positions to the retracted and inoperative position occurs simultaneously by release of the follower arm **91** from the drum cam **92**. In that release the lever **83** will move to the left as viewed in Fig. 13, or to the right as viewed in Fig. 4, thereby adjusting the actuators **98** and **104** so that the pins **102** and **106** will lie at the opposite ends of the respective cam slots with resulting retraction of the cams in the manner previously described in connection with the actuator **29** and cam **22**. Such retraction of the cams **81** and **82** may be independent of the cam **22**.

Fig. 3 shows a character of tuck stitch produced by the device of the present invention in dual feed operation. In this fabric the yarn forming the respective courses are fed successively to the needles from yarn feed station **1** associated with the cams **17** and **18** and yarn feed station **2** associated with the cams **81** and **82**, see Fig. 5. In Fig. 3, these yarns are designated *x* and *y* respectively. In order to produce the illustrated tuck stitch, it is necessary that the cams **22** and **82** be retained in tucking positions during approximately one full revolution of the cylinder. In other words, the tucking needles must pass through both of the yarn feed stations successively without casting a loop. As previously set forth, the shaft **9** is given one complete oscillation for

every four complete rotations of the cylinder 1. Each full reciprocation of the saber cam 59 will therefore also embrace four revolutions of the cylinder, and the working stroke of the cam, i. e. the upward movement of the cam, will occur during two revolutions of the cylinder. It will be apparent that if the cam 59 at the beginning of the working stroke has been adjusted so that the upper end thereof lies in immediate proximity to the pin 58, the dwell of the cams in the tucking position will correspond to a certain substantial part of four revolutions of the cylinder, and in order to reduce this dwell, it will be necessary to adjust the cam so that at the beginning of the working stroke the upper end thereof lies relatively remote to the pin 58.

In performance of the machine in single feed operation, the opposite condition will prevail. In that case in order to form the tuck stitch illustrated in Fig. 3, it will be necessary that the tucking needles pass twice through the yarn feed station 1 without casting a stitch. Under these circumstances the dwell of the cams 22 and 82 will be relatively long, and in order to obtain this relatively protracted dwell the cam 59 is adjusted to a position wherein the upper end at the beginning of the working stroke will lie in relative proximity to the pin 58. It will be apparent that this adjustability of the cam 58 affords a certain flexibility also in the character of the tuck stitch, particularly in single feed operations. The device makes possible the use of the marking mechanism selectively for both single feed and dual feed operation, the change from dual to single feed requiring only disconnection in any desired manner of cams 81 and 82, and of the associated yarn feed, from their operating mechanisms, and adjustment of the cam 59 as described.

I claim:

1. In a circular knitting machine, a rotary needle cylinder, needles in said cylinder including selectively placed needles of relatively short butt length and other needles having longer butts, means for actuating the needles including those having the said short butts to produce the knitted machine product, said means including a clearing cam, means for diverting the said short butt needles from said clearing cam to form individual tuck stitches, said means including a needle depressing cam operative on all the needles and a following needle elevating cam adjustable selectively between alternative positions in one of which positions the cam operates to elevate the needles of both short and longer butt length and in the other of which positions the cam clears the said short butts and operates only on the needles of longer butt length, mechanism for so adjusting the last named cam including adjustable means for regulating the dwell of the cam in the last named operative position with reference to cylinder rotation, mechanism for further adjusting the said elevating cam between the first named of said alternative operative positions and a third position in which the cam is retracted and inoperative with respect to the needles, a pattern drum controlling the operations of the machine and a pattern chain for controlling the operations of the drum, means for operatively connecting the elevating cam with the drum for adjustment of the cam by the latter between the first named alternative position and the said retracted position, and means for operatively connecting the said cam with the chain for adjustment of the cam by the latter between the said alternative operative positions.

2. A circular knitting machine according to claim 1 wherein the means for operatively connecting the said cam with the drum and chain comprises a rock shaft and a drum follower lever on said shaft, a second rock shaft having a lost motion connection with the first named shaft providing for independent actuation of the latter by the drum, and means for operatively connecting the second shaft to the chain for intermittent actuation by the latter.

3. A circular knitting machine according to claim 2 wherein the operative connection between the second shaft and the chain comprises a shaft-actuating element normally traversable in a path remote from the shaft and in which path the element is inoperative to rock the shaft, said element being adjustable into a second path of traverse in which the element is operative in its traverse movement to rock the shaft, means operatively connected with the chain for selective adjustment of the element between said paths, and means for traversing the element.

4. A circular knitting machine according to claim 3 wherein the said means for operatively connecting the element and chain comprises elements projecting detachably in longitudinal series from a side of the chain, a rock lever having one end located in the path of said projecting elements, another arm of said lever having engagement with said cam, a spring tending to resist displacement of the lever by the projecting elements, and a second spring attached to the cam and exerting a lesser force on the lever tending to displace the lever against the pressure of the spring first named, said lever except when shifted by a chain element confining the cam to traverse in the said remote path.

5. A circular knitting machine according to claim 3 wherein the said element takes the form of a longitudinally reciprocatory saber cam, and the shaft has an arm and a pin extending transversely from the arm and engageable by the end of the cam in the longitudinal traverse movement of the latter to effect said displacement by the camming action of said end.

6. A circular knitting machine according to claim 5 wherein the dimensions of the cam end is limited so that when the required displacement of the lever is effected a continued movement of the cam retains the lever in displaced position by engagement of the pin with one longitudinal side of the cam, and wherein further means is provided for adjusting the terminal positions of the cam end with respect to the pin to thereby regulate the dwell of the lever in the displaced position in each reciprocating movement of the cam, said adjusting means constituting the means for regulating the dwell of the elevating cam in the operative position in which it clears the short butt needles.

7. In a circular knitting machine having a rotary needle cylinder, short butt needles in said cylinder together with needles of longer butt length, cam means cooperative with the short butt needles to form tuck stitches including a cam element adjustable between fully retracted and fully inserted positions and an intermediate position in which the cam clears only the said short butts, a pattern drum controlling the operations of the machine, a pattern chain controlling the movements of the drum, and means for traversing the chain in predetermined timed relation with the cylinder, drum actuated mechanism for adjusting the cam element between the fully retracted and fully inserted positions, and chain actuated mechanism for independently adjusting the cam element between the fully inserted and intermediate positions.

8. A circular knitting machine according to claim 7 wherein the chain actuated mechanism includes adjustable devices for varying the dwell of the cam element in the intermediate position.

9. In tuck stitch mechanism for circular knitting machaines, a rotary cylinder and needles in said cylinder, a needle cam, a pattern chain and means for traversing the chain in timed relation with the rotary movements of the cylinder, chain actuated means for adjusting said cam between operative and inoperative positions, said means comprising a rock shaft, an arm on said shaft and a transversely projecting pin on said arm, a saber cam, means operating in timed relation with the chain traverse for longitudinally reciprocating the cam selectively in each of two paths, in one of which the terminal end of

the cam engages the pin to displace the arm and rock the shaft, and in the other of which the said terminal end avoids the pin, and chain-controlled means for adjusting the saber cam into the respective paths.

10. Tuck stitch mechanism according to claim 9 wherein the said terminal end of the cam is limited dimensionally so that a working stroke of the cam of predetermined length results in a displacement of the pin from the said end of cam and retention of the lever and shaft in the displaced position by contact of the pin with a longitudinal side of the cam, and wherein further means is provided for adjusting the cam with respect to its reciprocating means to adjust the proximity of said cam end to the pin at the initiation and termination of the said working stroke.

11. In a circular knitting machine having a rotary needle cylinder and needles in said cylinder, a pattern chain and means for traversing the chain in timed relation with the rotary movement of the cylinder, a pattern drum controlling the operations of the machine, and means controlled by the chain for rotating the drum, means for feeding yarn to the needles in each of two stations at opposite sides respectively of the cylinder, stitch cams for the needles at each of said stations, tuck-stitch-forming cam means operatively associated with each of the said stitch cams, means actuated by the drum for adjusting each said cam means independently of the other between a fully retracted inoperative position and a fully inserted inoperative position, and common means actuated by the chain for adjusting the two cam means between the fully inserted position and an operative intermediate position.

12. A circular knitting machine according to claim 11 wherein the drum-actuated means comprises a pair of rock shafts connected respectively to the cam means and each having a follower arm in operative engagement with the drum for displacement by separate cams on the latter.

13. A circular knitting machine according to claim 12 wherein the chain-actuated means comprises a third rock shaft operatively connected to both cam means, an actuator for said shaft operatively connected with the chain-traversing means, and means actuated by the chain for selectively operatively connecting and disconnecting the actuator with and from the shaft.

14. A circular knitting machine according to claim 13 wherein the said chain-actuated connecting means comprises adjustment means for selectively regulating the relative timing of the traverse movements of the chain and the accompanying actuations of the shaft.

15. A circular knitting machine according to claim 11 wherein one of said cam means includes two separate cam elements movable as a unit between the fully retracted and fully inserted positions, means being provided for connecting one element only of said pair to the said common adjusting means for adjustment individually between the fully inserted and intermediate positions.

16. A knitting machine according to claim 11 including means for rendering one of said feed means and the associated tuck stitch cam means selectively operative and inoperative for dual and single feed operation of said machine respectively, and means for adjusting the said common adjusting means to vary the dwell of the said cam means in the said intermediate position with reference to cylinder rotation in accordance with the differing requirements of the single and dual feed operations.

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