Oct. 29, 1940. M. ZIMIC 2,219,607

KNITTING MACHINE AND METHOD

Filed May 25, 1939 6 Sheets-Sheet 1

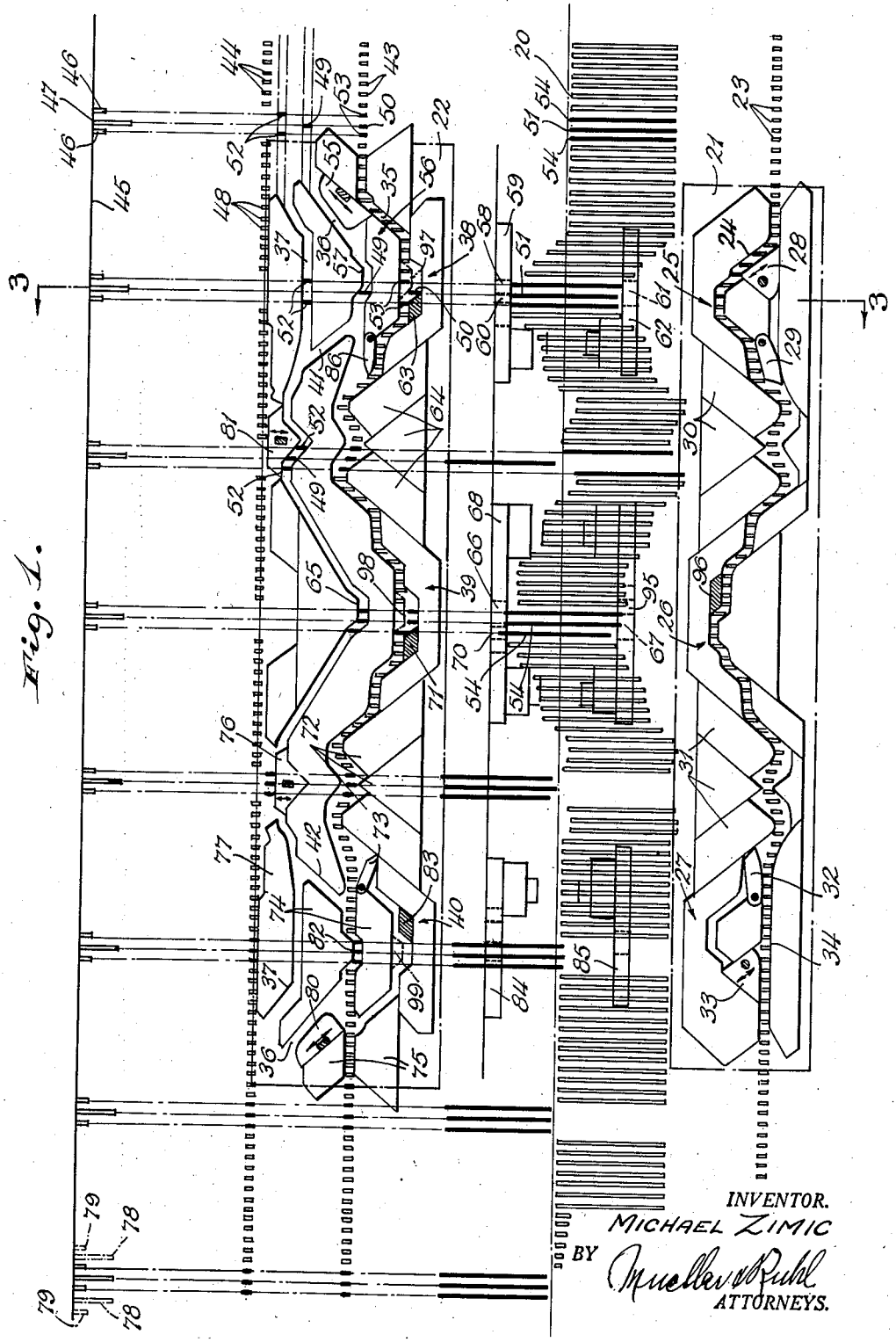


Fig. 1.

INVENTOR.
MICHAEL ZIMIC
BY Mueller & Ruhl
ATTORNEYS.

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KNITTING MACHINE AND METHOD

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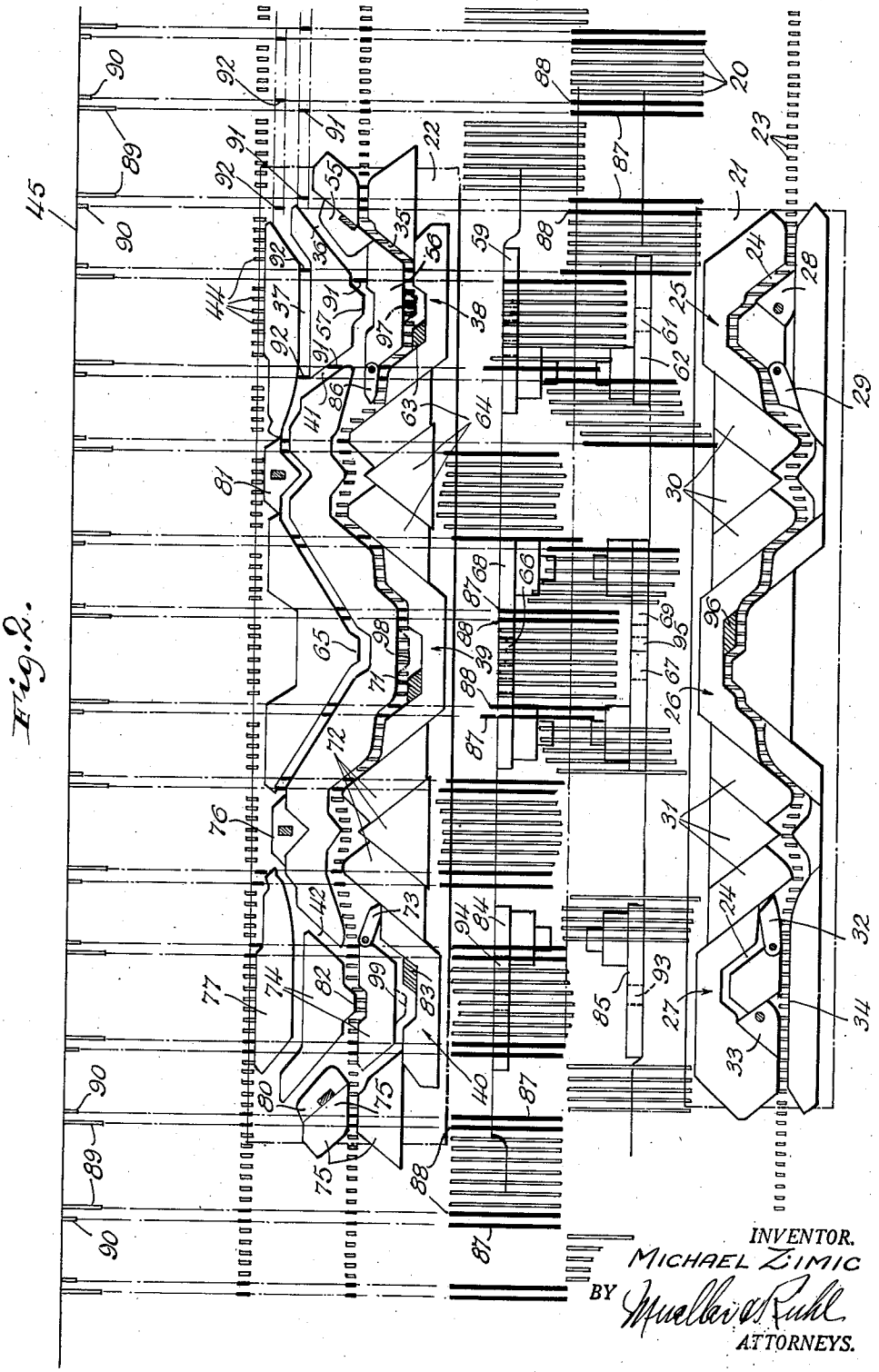


Fig. 2.

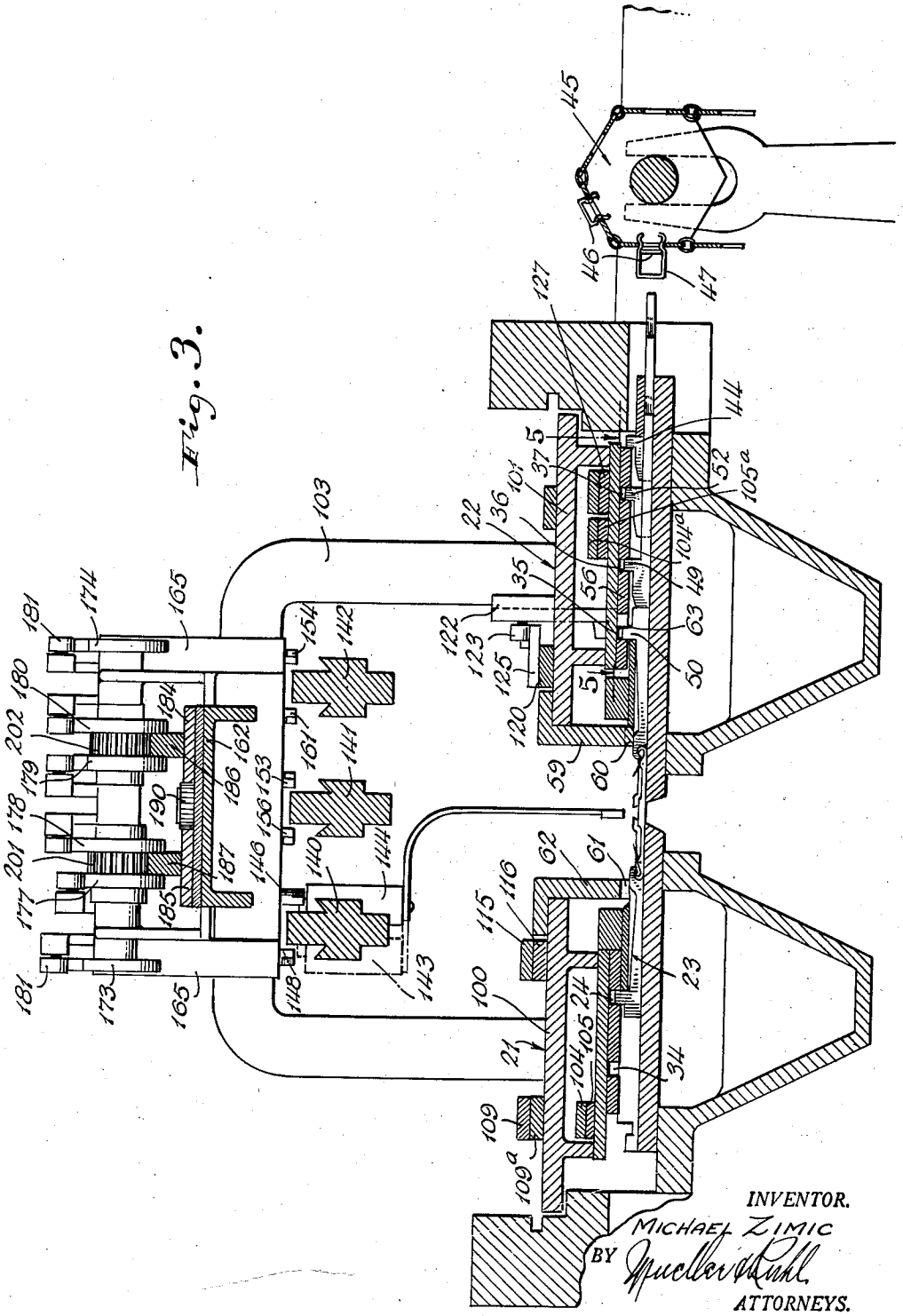
INVENTOR.
MICHAEL ZIMIC
BY Mueller & Ruhl
ATTORNEYS.

Oct. 29, 1940. M. ZIMIC 2,219,607

KNITTING MACHINE AND METHOD

Filed May 25, 1939 6 Sheets-Sheet 3

Fig. 3.



INVENTOR.
MICHAEL ZIMIC
BY Mueller & Ruhl
ATTORNEYS.

Oct. 29, 1940. M. ZIMIC 2,219,607

KNITTING MACHINE AND METHOD

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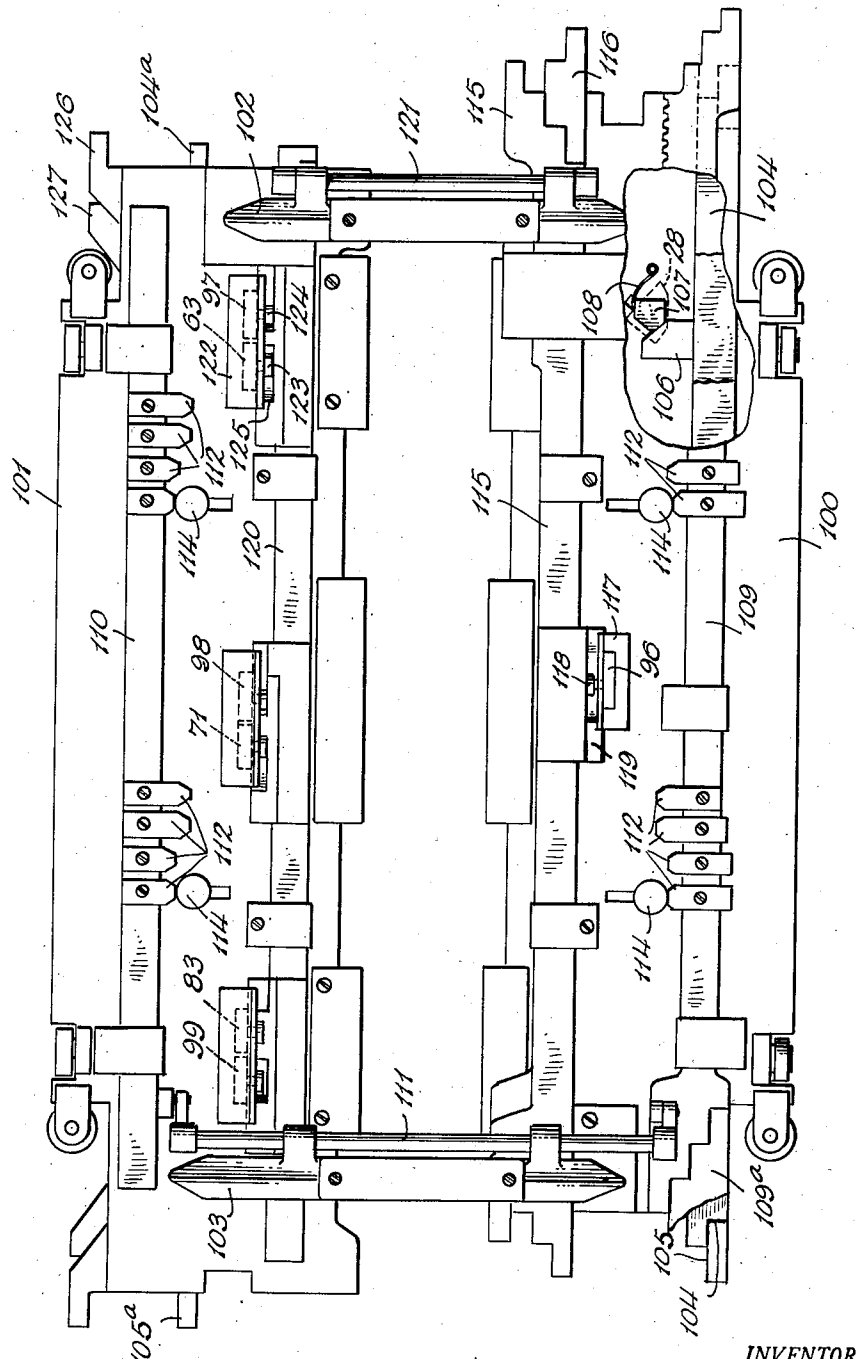


Fig. 4.

INVENTOR.
MICHAEL ZIMIC
BY Mueller & Aichele
ATTORNEYS.

Oct. 29, 1940. M. ZIMIC 2,219,607

KNITTING MACHINE AND METHOD

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Fig. 5.

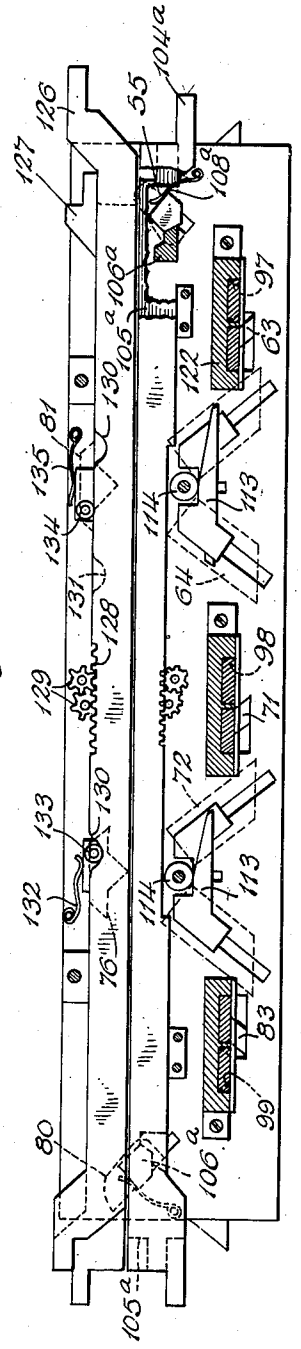


Fig. 8.

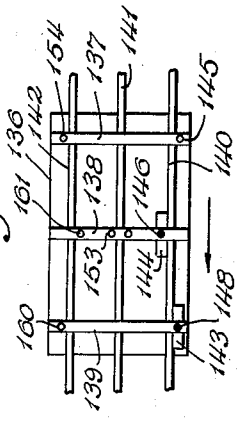


Fig. 7.

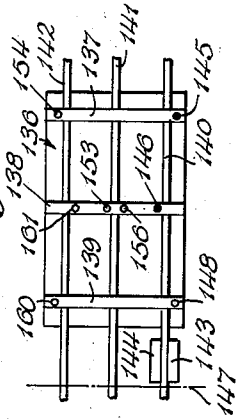


Fig. 6.

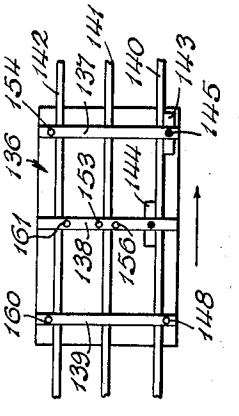
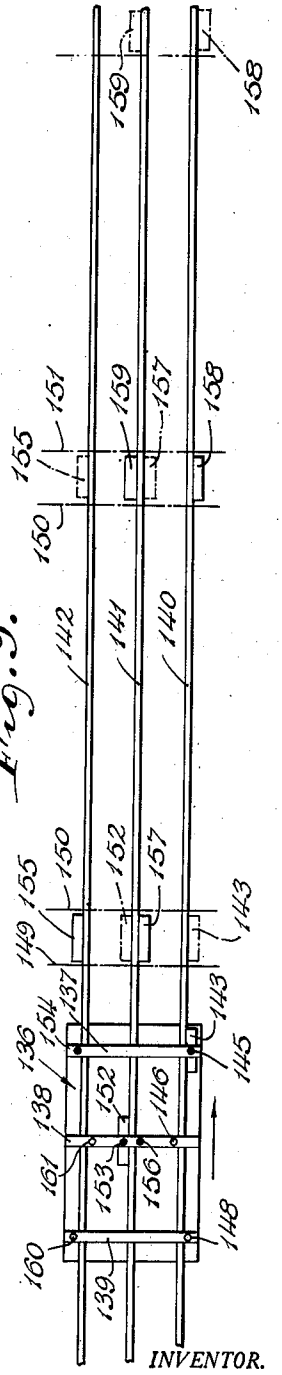


Fig. 9.



INVENTOR.
MICHAEL ZIMIC
BY
ATTORNEYS.

Oct. 29, 1940. M. ZIMIC 2,219,607

KNITTING MACHINE AND METHOD

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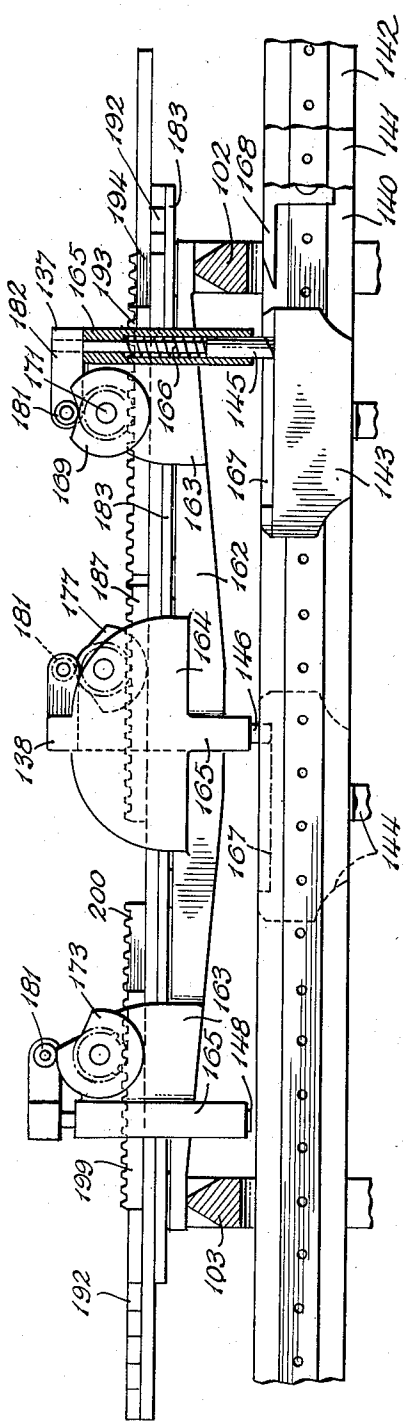


Fig. 10.

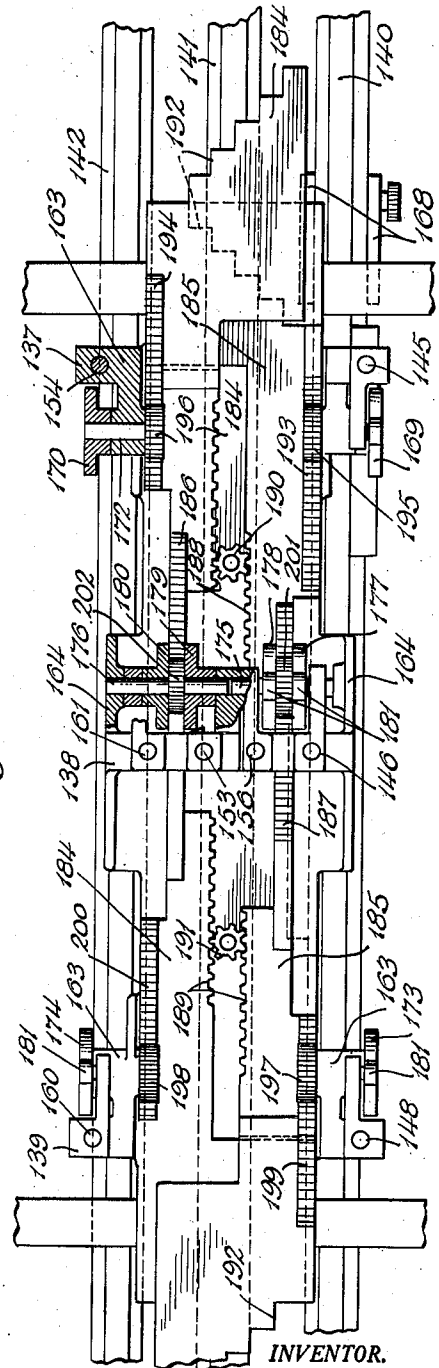


Fig. 11.

INVENTOR.
MICHAEL ZIMIC
BY Mueller & Pahl
ATTORNEYS.

Patented Oct. 29, 1940 2,219,607

UNITED STATES PATENT OFFICE

2,219,607

KNITTING MACHINE AND METHOD

Michael Zimic, Forest Hills West, New York, N. Y.

Application May 25, 1939, Serial No. 275,642

9 Claims. (Cl. 66—63)

This invention relates to improvements in the art of knitting and has particular reference to a method and machine for accomplishing knitting operations at a plurality of positions during a single course of travel of the lock mechanism of the machine.

An object of the invention is to preselect certain needles of a machine for transfer from one bed to another at one of a plurality of knitting positions so as to accomplish knitting operations thereat during one course of travel of a lock mechanism, and to preselect other needles for similar transfer at another knitting position, during said course of travel, so as to perform knitting operations at said other positions at which the first named needles again operate to form stitches.

The inventive idea involved is capable of receiving a variety of expressions one of which, for purposes of illustration, is shown in the accompanying drawings, in which:

Figure 1 is a diagrammatic top plan view of a lock mechanism constructed in accordance with the present invention and illustrating the position of parts at the beginning of the formation of a design in a piece of fabric being knitted.

Figure 2 is a view similar to Figure 1 showing the position of parts at an advanced stage of the formation of said design.

Figure 3 is a transverse section taken through the lock mechanism and associated parts, substantially on the line 3—3 of Figure 1.

Figure 4 is a top plan view, partly broken away, of the lock mechanism employed in connection with the present invention.

Figure 5 is a horizontal section of the rear portion of the lock mechanism taken substantially on the line 5—5 of Figure 3.

Figures 6, 7 and 8 are diagrammatic views illustrating various positions of the yarn control mechanism when a single continuous piece of fabric is knitted by the machine.

Figure 9 is a diagrammatic view illustrating the operation of the lock mechanism and yarn control when a plurality of separate pieces of fabric are being knitted by the machine.

Figure 10 is a side elevation, partly broken away and shown in section, of the yarn control mechanism, and

Figure 11 is a top plan view of said mechanism, partly broken away and shown in section.

With the present machine and according to the instant method, it is possible to knit various types of stitches such as plain ones which are formed by operating all the needles from the front bed of the machine; purl stitches such as are made by alternately shifting or transferring all the needles from one bed to another; and links and link stitches that are made by transferring certain selected needles from the front to the rear bed and operating said needles from the rear bed to form various designs in the knitted fabric.

Reference will first be made to Figures 1 and 2 in which there is shown diagrammatically the lock mechanism and associated parts embodying novel features of the present invention. In Figure 1, there is illustrated the first step in forming a design, such as a diamond for example, in which, according to one of the principal features of the invention, the number of links and link stitches is varied (progressively increased in a diamond design) in the two initial, concurrently formed rows during a single course of travel of the lock mechanism from left to right and at two different knitting stages; while Figure 2 shows the final step in the operation wherein the two rows of stitches forming the next greatest and the greatest widths of the first half of the design are also made in a single movement of the lock mechanism from left to right and at two different stages in this movement. More specifically, in the first movement of the lock mechanism, three needles are preselected to form the first two rows of the design and, in accordance with the present invention, one of said needles forms stitches in both said rows, while the other two needles form stitches only in the second row. For the next movement of the lock mechanism from right to left, four needles are preselected, two on each side of the first needles and two of said four needles form stitches in the next two rows while the remaining two needles make stitches only in the fourth row. During the latter movement of the lock mechanism, the needles first preselected and which formed the initial two rows, also make stitches in the third and fourth rows. Then, with the final movement of the mechanism (Figure 2) which produces the greatest width of the design, four more needles are preselected, two on each side of the previously operated needles, and the same operation referred to takes place to produce the fifth and sixth rows of stitches. From the point of greatest width, the number of stitches in each of the succeeding rows is progressively decreased, as will be hereinafter apparent, to complete the diamond design. It will be understood, of course, that the diamond referred to is only illustrative of one of innumerable designs which may be accomplished within the scope of the invention, since the needles em-

ployed to form any design are selectively operable at will by a means such as a jacquard mechanism.

In Figures 1 and 2, the reciprocating lock mechanism of the knitting machine, which travels over and operates the various needles **20**, comprises the front and rear lock assemblies generally indicated by the numerals **21** and **22**. The front assembly **21**, which travels over the front bed of the machine, is utilized to control the needle jacks the butts of which are indicated at **23**. Insofar as the assembly **21** is concerned, the same is more or less of standard construction in which a series of cams are combined to form a channel **24** by means of which the butts **23** are guided through a series of knitting positions during one course of travel of the lock mechanism; that is, a movement thereof in one direction as distinguished from a complete round of travel. These knitting positions are generally indicated at **25**, **26** and **27**. When the lock mechanism is moving from left to right, knitting operations are effected at positions **25** and **26**, and when moving from right to left, knitting operations are performed at positions **27**, **26**. The parts of the lock mechanism, as shown in Figures 1 and 2, are disposed for operation during the movement of the mechanism from left to right, and consequently, knitting is taking place at positions **25** and **26**. A movable lock **28** adjacent the right-hand entrance to the channel **24** is adjusted so that the butts **23** of the needle jacks will be advanced toward the first position **25**, and, after being so advanced to similarly operate an associated needle in the customary manner, the jacks and needles are retracted and pass a pivoted lock **29** of a known type which is spring pressed to normally close the channel **24**. At this point, after the lock mechanism has passed over the jacks, the customary stitch cams **30** then become effective to tighten the loops formed at the first knitting position, after which the same operation is repeated at position **26** and the stitch cams **31**. A pivoted lock **32**, similar to the lock **29**, is in its normal position, and a slidable lock **33**, similar to the lock **28**, is in an advanced position. Consequently, the butts **23**, after being passed by the stitch cams **31**, are guided through the rear channel **34**, and no knitting operation is performed at position **27**. Thus through the single movement of the lock mechanism from left to right, all needles then in the front bed of the machine are operated to form what may be referred to as plain stitches at the two positions **25**, **26**. On the movement of the lock mechanism from right to left the positions of the locks **28**, **33** are reversed and, as a consequence, the needle jacks will be caused, by the lock **33**, to first enter the knitting position **27** after which they pass the pivoted lock **32** and the stitch cams **31** to the knitting position **26** from whence they pass out of the mechanism in back of the knitting position **25**.

The rear assembly **22** of the lock mechanism comprises a series of locks which combine to form front, intermediate and rear butt channels **35**, **36**, and **37**, and three knitting positions generally indicated at **38**, **39**, and **40**; the two positions **38**, **39** being effective during the left to right movement of the lock mechanism while knitting operations are performed at positions **40**, **39** on the right to left movement of the mechanism. At the points **41** and **42** adjacent the positions **38** and **40** the channels **36** and **37** communicate with each other for a purpose which will appear in the course of the description. The butts **43** of the rear needle jacks pass through the channel **35** and are either operated or not, for knitting purposes, depending upon the positions of the associated jacquard or push jacks whose butts are shown at **44**.

When it is desired to transfer or shift needles from the front to the rear bed to form links and link stitches, a jacquard mechanism, conventionally indicated at **45**, is employed to control the advance of the jacks **44** to either one of two positions so that certain of the butts of said jacks will enter channel **36** while others will enter channel **37**. By such operations of the jacquard jacks, there is accomplished a preselection of those needles which are to be transferred to the rear bed of the machine and subsequently operated to form stitches of a design, and the advancement of said jacks **44** to different positions results in the transfer, at the first knitting position **38**, of the front needle opposed to the more advanced jack or jacks; also, the more advanced jack joints, through the communicating channel **41**, with the lesser advanced jacks **44** so that at the second position **39**, the transferred needle, or needles, performs another knitting operation while the needles in the front bed opposed to the lesser advanced jacks **44** are transferred, at said position **39**, to the rear bed to also form stitches. The advancement of the jacquard jacks to different positions is accomplished through the use of short and long pattern lugs or clips **46** and **47** which may be of the type disclosed in U. S. Patent #1,701,522 dated February 12, 1929. It may be said at this point that when all the needles are being operated by the front assembly **21** to form plain stitches, the jacquard mechanism **45** does not operate to advance the jacks **44** and, consequently, the butts of these jacks will pass to the rear of the assembly **22**, as indicated at **48**. Therefore, the rear needle jacks **43** will not be advanced to engage a front needle and transfer the same to the rear bed.

A specific knitting operation involving the formation of a design will now be described and, for this purpose, there has been selected, as illustrative, a design of diamond shape wherein the links and link stitches forming said design are progressively increased in succeeding knitted rows until the greatest width of the design is attained, and are then progressively decreased until the design is complete. Let it be assumed that, at the beginning of the operation, all the needles are in the front bed, and that needles are to be preselected from said front bed to form the first two rows of the knitted design, each containing a different number of stitches and both formed during a single movement of the lock mechanism from left to right. The first step in the operation is shown in Figure 1, wherein the jacquard mechanism **45** has been moved to a position in which two short pattern lugs **46** are disposed on opposite sides of a long lug **47**. As the mechanism is advanced in the usual manner, the long lug **47** will first contact the opposed jack **44** and advance the same to the position indicated at **49** where it will be aligned with the entrance to the intermediate channel **36**. The advancement of the jack preselects the associated needle jack **50** in the rear bed and also the opposed needle **51** in the front bed, for a transfer and knitting operation at position **38**. As the jack **49** is advanced, the lugs **46** also advance the jacquard jacks **52** to a position where they are aligned with the rear channel **37**, and the advancement of said jacks **52** preselects the cor-

responding rear needle jacks 53 and needles 54 in the front bed. However, according to the present invention, the transfer of the two needles 54 is not effected until the second knitting stage 39 is reached. Thus, by the preselection just described, a single stitch is made by the needle 51 at position 38 to form the first row of the design, and the concurrently formed second row containing three stitches made by the one needle 51 and the two needles 54, is accomplished at position 39.

The three needles having now been preselected for the first operation, the lock mechanism starts its movement from left to right and those needles in the front bed which have not been preselected are operated in the ordinary manner by the front lock assembly 21 to form plain stitches because the non-advanced jacquard jacks 44 pass to the rear of the assembly 22. At the right-hand entrance to the intermediate channel 36, there is provided a slidable lock 55 which is advanced during the present operation so as to open the channel 36 at this point and close communication between said channel and the channel 35. Therefore, the butts 43 of all the rear needle jacks will be guided to the channel 35, and the butt of the more advanced jacquard jack 49 will enter the channel 36, while the butts of the two jacks 52 will enter the channel 37. It will be understood that, at this point of the operation, the jacquard jack 49 is not advanced sufficiently far to contact the rear end of the associated needle jack 43 and that this contact is not made until the actual transfer of the needle 51 is effected at the knitting position 38; also, all of the butts of the needle jacks 43 with the exception of the jack 50 will follow the course indicated along the forward edge of the cam 56. At this knitting position 38, the jacquard jack 49 is advanced by the cam 57 to contact the needle jack 50, with the result that the latter is also advanced to the position shown to engage the adjacent hook of the needle 51 which has been advanced by its front jack 23 at the position 25. A recess 58 in the lower edge of a cam 59 permits the engagement of the rear needle jack with the hook of the needle 51, in a manner well-known in the art, and when said needle has moved past said recess, to the position shown in the drawings, and its upper edge is engaged by the projecting portion 60 of said cam 59, said portion will maintain said engagement of the needle jack and hook, while a recess 61 formed in the bottom edge of a cam 62 in the front assembly 21, under which the front ends of the needle 51 and its associated front jack 23 pass, will permit said front jack to tilt upwardly to disengage from the front hook of the needle as a rearward pull is exerted upon the latter by the jack 50. This rearwardly pull is accomplished by the means of a lock 63 located in the channel 35 at the knitting position 38, which lock is lowered at this point of the operation so as to be contacted by the butt of the rear needle jack 50 whereby the latter is retracted to start the transfer of the needle 51 to the rear bed. As the movement of the lock mechanism progresses the various butts of the rear needle jacks are further retracted by the stitch cams 64 and the needle 51 is withdrawn to the rear bed to complete the first stitch in the design. The butt of the advanced jacquard jack 49, after passing the cam 57, enters the communicating channel 41 between the channels 36 and 37, and there joins the butts of the jacquard jacks 52 which, due to their lesser advanced stage, have performed no operation of advancing any jacks 43 at position 38. Upon reaching the second knitting position 39, the butts of the jacquard jacks 49, 52, are advanced by the cam 65 and, in so doing, said jacks advance the associated rear needle jacks 50, 53, with the result that the transferred needle 51 is operated preparatory to form a stitch and the front ends of the needle jacks 53 are engaged with the adjacent hooks of the two needles 54 then in the front bed. The recesses 66 and 67 in the two cams 68 and 69, and the adjacent projecting portion 70 of the cam 68, then cooperate in conjunction with the lowered lock 71 in the channel 35, as described in connection with the cams 59, 62, and lock 63, to effect the transfer of the two needles 54 to the rear bed to form the three loops of the second row of stitches of the design. The usual stitch cams 72 then operate the rear needle jacks in the customary manner after which the latter pass the pivoted spring-pressed lock 73 which, at this time, is swung forward to close the entrance to the final knitting position 40. The butts of said needle jacks then pass out of the lock mechanism between the pairs of opposed cams 74 and 75. After passing the cam 65, the three jacquard jacks 49, 52, are retracted in the channel 37 and successively pass to the rear of the advanced movable cam 76 and the stationary lock 77, at which point said jacquard jacks join the row of jacks 48 which have not been operated upon by the jacquard mechanism 45. Thus, the first operation of forming two complete rows of the design, each including different numbers of stitches, is completed.

Before the lock mechanism starts its second movement, from right to left, to form the next two rows of the design containing different numbers of stitches, four more needles are preselected for transfer from the front to the rear bed, and adjustments of certain of the locks in the two assemblies 21, 22 are effected. The preselection of the four additional needles is accomplished, as before, through the medium of the jacquard mechanism 45. As said mechanism is operated preparatory to the next knitting performance, two long and two short pattern lugs indicated in dotted lines by the numerals 78 and 79 at the upper left-hand corner of Figure 1, are brought into alignment with corresponding jacquard jacks, it being understood that the first three pattern lugs 46, 47 employed in the first operation have now been passed out of the alignment with the jacquard jacks by the mechanism 45 which brought the lugs 78, 79 into alignment with said jacks. Before the carriage starts its movement from right to left, the positions of the two locks 28, 33, in the front assembly 21 are reversed. Also, in the rear assembly 22, the positions of the lock 55 and the corresponding lock 80 at the left-hand end of the assembly, are reversed. Further, the lock 76 is retracted and the corresponding lock 81 advanced.

In the jacquard mechanism 45, the two long lugs 78 are disposed outside the positions in which the short lugs 46 are arranged, while the two short lugs 79 are outside the long lugs 78. Thus, as the mechanism 45 is actuated to advance these various lugs, the four jacquard jacks opposed to said lugs are advanced to different positions, as will be apparent from the previous description, so that the butts of the two furthest advanced jacks will enter the left hand end of the channel 36 while the jacks advanced by the lugs 79 will enter the rear channel 37, as the lock

mechanism starts its movement from right to left. With the sliding lock 80 now in its advanced position, which is the position in which the corresponding lock 55 at the other end of the channel 36 is shown, the butts of the rear needle jacks 43 will be advanced into the first knitting position 40. When the two more advanced jacquard jacks in the channel 36 are actuated by the cam 82, the two opposed needles in the front bed are engaged by the forward ends of the rear needle jacks and a transfer of said needles to the rear bed is effected when the advanced needle jacks engage the vertically movable lock 83 which is lowered at this time, and which corresponds to the lock 63 at position 38. The recessed cams 84 and 85 at position 40, corresponding to cams 59, 62 at position 38, assist in the transfer operation of the needles in the manner which is now believed to be understood from the foregoing description. With respect to the three needles which were transferred to the rear bed during the first operation of the carriage, the needle jacks to which said needles are now connected, and which are directed into the channel 35 by the lock 80 at position 40, are controlled in the customary manner by the front cam 74 to perform the usual knitting operation. Thus, at said knitting position, where the third row of the design is being knitted, the three original needles combine with the two needles on opposite sides thereof which are being transferred at this stage of the operation to form five stitches. The two further advanced jacquard jacks, after being engaged by the cam 82 to perform the transfer operation, pass into the communicating channel 42 between the channels 36 and 37 and then join the two lesser advanced jacquard jacks which have been actuated by the short lugs 79. After the four jacks are joined the same pass in front of the then retracted lock 76 and all four jacks approach the second knitting position 39. At this point said jacks are advanced by the cam 65 and the two jacks which accomplished the transfer of two of the needles at position 40 again operate their needle jacks to cause the associated needles in the rear bed to again form stitches. The other two jacquard jacks, which originally entered the channel 37, operate their associated needle jacks to advance the same so as to effect the transfer of the associated needles from the front to the rear bed and to form additional stitches. At knitting position 39, the three needles which were transferred to the rear bed on the first operation of the lock mechanism are again actuated by their needle jacks to form stitches in the customary manner. Therefore, at this position, where the fourth row of the design is being knitted, stitches are formed by the three originally transferred needles and the four adjacent needles on opposite sides thereof. After the needle jacks have passed the knitting position 39 and the stitch cams 64 the same will be directed, by the pivoted lock 86 which is now in the position of the corresponding lock 73 shown at position 40, into the channel 36 between the cams 56 and 57, from whence the butts of said jacks exit from the lock mechanism in the same manner as described in the first operation. The second operation of said mechanism is thus completed.

Referring now to Figure 2, there is shown therein the final operation in completing the first half of the diamond design, in which operation four more needles for each repeat of the design are preselected prior to the movement of the lock mechanism from left to right as in the first operation. These needles are indicated at the lower right-hand end of Fig. 2 by the numerals 87 and 88, the needles 87 being preselected by the two long pattern lugs 89 in the jacquard mechanism 45, while the needles 88 are preselected by the short lugs 90. In the same manner as previously described, the lugs 89 advance the associated jacquard jacks 91 into alignment with the intermediate channel 36, while the short lugs 90 advance the jacks 92 into alignment with the rear channel 37. As the lock mechanism moves to the right the rear needle jacks of the seven needles which have been previously transferred to the rear bed are again operated at position 38 by the cam 56 to form seven stitches in the fifth row of the design and, in addition to the operation of these needles, the cam 57 operates the jacquard jacks 91 so as to advance the corresponding needle jacks for the purpose of engaging the opposed needles 87 in the front bed and transferring the same to the rear bed at position 38 to add two more stitches to said fifth row of the design. At the same time that the jacks 91 are so controlled, the butts of the jacks 92 pass through the channel 37 to the rear of the cam 57 so as not to perform any operation at position 38. After being actuated by the cam 57, the jacks 91 are guided through the communicating channel 41 into the channel 37 where they join the jacks 92. After passing in front of the lock 81, which is at this time retracted, the four jacks 91, 92 are advanced toward the second knitting position 39 whereat, as previously, the two needles which were transferred at position 38, together with the seven previously transferred needles are again operated to form stitches; and the needles in the front bed opposed to the jacks 92 are engaged by the corresponding needle jacks in the rear bed to shift said needles to the latter bed so as to form two additional stitches, thus making eleven stitches at position 39 to complete the sixth and final row representing the greatest width of the design. As heretofore described, after the needles have passed the second knitting position and have been actuated by the stitch cams 72 the jacks of said needles exit from the lock mechanism between cams 74, 75, while the four jacquard jacks utilized to control the last operation pass behind the lock 76 and join the remaining similar jacks in back of the cam 77.

Upon completion of the fifth and sixth rows of design stitches, the operation of progressively decreasing the number of stitches in each two rows formed by one movement of the lock mechanism, is accomplished. The first decrease in the number of said stitches occurs during the next movement of the lock mechanism from right to left. Before this movement starts, the jacquard mechanism 45 is again operated in the usual manner to adjust to operative position, with respect to jacquard jacks, certain pattern lugs which will be effective in preselecting the proper rear needle jacks necessary to transfer associated needles from the rear to the front bed of the machine to accomplish the progressive reduction of the number of design stitches. Generally speaking, this progressive reduction occurs in the same manner as described in connection with the increase in the number of stitches of the different rows in the design; that is to say, at the first knitting position 40 on the movement of the mechanism toward the left, the two extreme needles 87 of the eleven needles which

were transferred to the rear bed to complete the row of stitches forming the greatest width of the design are now transferred from the rear to the front bed; while at the second knitting position 39 the next two outside needles 88 are similarly transferred, so that in the single movement of the lock mechanism from right to left two rows of stitches are made in which the number of said stitches in each row is first reduced to nine and then to seven. To attain this result, the pattern lugs on the jacquard mechanism are arranged in a reversed position from that which is shown at the upper left-hand corner of Figure 2. In other words, where the short lugs 90 are shown in the latter figure, two long lugs are mounted in corresponding positions on the jacquard mechanism, and where the two long lugs 89 are shown, there are mounted two short lugs. With this reversed arrangement of pattern lugs, it will be apparent that as the jacquard mechanism is moved forward, the two long lugs individual to the extreme outside needles 87 will advance the associated jacquard jack butts to positions in alignment with the left-hand entrance of the intermediate channel 36, as described in connection with the jacks 91; while the two short lugs of the jacquard mechanism will align the associated jacquard jack butts with the rear channel 37. Also, before movement of the carriage from right to left, the positions of the sliding locks 80 and 55, at the entrances to the channel 36 as shown in Figure 2, are reversed; and the locks 63, 71, and 83 at the three knitting positions of the rear assembly are raised so as to be inoperative during the reciprocating movement of the lock mechanism and while the lengths of the rows of the design stitches are being decreased.

With the foregoing conditions existing, the lock mechanism starts its movement from right to left and the butts of the front and rear needle jacks 23, 43 enter their respective channels 34 and 35 at the left-hand end of the lock mechanism. Also, the two jacquard jacks which have been furthest advanced enter the left-hand channel 36 while the other two jacquard jacks advanced by the short pattern lugs enter the channel 37. In the front assembly 21 of the lock mechanism, the positions of the two locks 33, 28 are reversed from that shown in the drawings and, therefore, butts 23 will be advanced toward the knitting position 27. Likewise, the butts of the rear needle jacks are guided forwardly to the knitting position 40 so as to pass in front of the forward cam 74 at said position. The two butts of the jacquard jacks entering the intermediate channel 36 are advanced by the rear cam 74 and upon reaching the knitting position are further advanced by the cam 82 forming a part of said rear cam 74. As each jacquard jack is advanced by the cam 82 it also advances the corresponding needle jacks to a position similar to that of the needle jack 50 (Figure 1). Immediately following this advancement, the opposed front needle jack reaches its furthest advanced point at position 27 in the front assembly and, at the same time, attains a position beneath the recess 93 in the lower surface of the cam 85, so that the forward extremity of said needle jack will engage over the hook of the needle in the rear bed which has been advanced by engagement of the associated rear needle jack with the lock 82. With the lock 83 raised to an inoperative position out of the path of travel of the advanced butt of the rear needle jack, said butt will continue its travel in a straight line beneath said lock 83 until the butt of the corresponding front needle jack starts its retracting movement in the channel 24 at position 27. At this instant, the engaged ends of the front needle jack and the hook of the needle then in the rear bed, will have passed beyond the recess 93 in the cam 85 and the under-surface of said cam will maintain such engagement. At the same time, the rear hook of said needle and the forward end of the rear needle jack will pass beneath the recess 94 in the cam 84 and, therefore, as the front needle jack is retracted in the channel 24, the rear hook of the needle will release itself, because of said recess 94, from the forward end of the rear needle jack and the needle will therefore be transferred from the rear to the front bed to form a plain stitch. The other needle 87 is actuated in the same manner as just described and, as a consequence, at the first knitting position 40, the number of design stitches will be reduced to nine.

The front and rear needle jacks now pass from the opposed needle positions 27, 40, toward the stitch cams 31, 72 respectively, while the butts of the two jacquard jacks which have been actuated by the cam 82 will pass into the rear channel 37 through the communicating channel 42 and join the butts of the other two jacquard jacks which have entered said channel 37. During this present operation, the sliding lock 76 is retracted while the similar lock 81 is advanced. Therefore, the four butts of the jacquard jacks will pass in front of the lock 76 and will thereafter be advanced toward the second knitting position 39. At this position, the four jacquard jacks will be advanced by the cam 65, but the advancement of the two jacks which have effected the transfer of the needles 87 to the front bed at the first knitting position has no effect at the second position. However, the two other jacquard packs associated with the two needles 88 advance the corresponding rear needle jacks and their needles and this operation, in cooperation with the advancement of the front needle jacks 23 at position 26, results in the transfer of the two needles 88 from the rear to the front bed in the following manner. At the furthest advanced position of each front needle jack, the rear end thereof will pass beneath the recess 67 in the cam 69 and will engage with the front hook of the needle 88 which has been advanced by its jacquard jack through engagement of the latter with the lock 65. After passing beneath the recess 67, the front end of the needle is held in the hook of the front needle jack by engagement of said parts with the lower edge portion 95 of the cam 69 and, at the same time, the rear hook of the needle and its associated rear needle jack pass beneath the recess 66 in the cam 68. Vertically adjustable lock 96, at the front knitting position 26, is lowered to its operative position at this time and is effective to start the retraction of the front needle jacks. Consequently, as this retraction occurs, with the rear end of the front jack and the front hook of the needle beneath the portion 95 of the cam 69 and the rear hook of the said needle in the recess 66 in the cam 68, the needle 88 will be withdrawn from the rear bed into the front bed. As both of the needles 88 are so shifted, the number of needles in the rear bed forming design stitches is reduced to seven. Passing from the second knitting position, the butts of the front and rear needle jacks asd the jacquard jacks will exit from the lock mechanism in the same manner as previously described without any knitting

operation being performed at the third position 25, 38.

Prior to the next movement of the lock mechanism from left to right, preselection of four more rear needle jacks and their associated needles, with the consequent transfer of two of such needles from the rear to the front bed at position 38 and the other two needles at the second position 39, is accomplished in a manner which is now believed to be understood from the prior description of the movement of the lock mechanism from right to left. Thus this reduction operation is repeated during each course of travel of the lock mechanism until the diamond design is completed.

In a purling operation wherein all of the needles are alternately shifted from one bed to another at each of the knitting positions, the jacquard mechanism 45 is inoperative so that all of the jacquard jacks 44 will pass along the rear assembly 22 without having any effect upon the rear needle jacks. Assuming that at the beginning of a purling operation the lock mechanism is at the left-hand end of the machine and all of the needles 20 are in the front bed thereof, the front jacks 23 enter the channel 24 of the front assembly and are operated in the same manner as previously, while the rear needle jacks 43 enter the channel 35 of the rear assembly, upon movement of the lock mechanism from left to right. The front needle jacks 23 and the needles are advanced at position 25, and at position 38 the vertically adjustable lock 63 is lowered to its operative position and a similarly adjustable lock 97 in the channel 35, which has been raised and out of operation, is now also lowered to its operative position. Under this condition, the rear needle jacks are advanced by said lock 97 to assume the same position as described in connection with jack 50 shown at position 38 in Figure 1. The advancement of all of the rear needle jacks in this manner causes them to engage the adjacent hooks of the associated needles in the front bed and, through the intermediary of the cams 59, 62 and the recesses therein, and the cooperation of the lock 63, said needles are transferred from the front to the rear bed in a manner which is now believed to be understood from the previous description. At the second knitting position 39, the lock 71 is now raised out of its operative position while a lock 98, similar to the lock 97 at position 38, is lowered to its operative position so as to advance the rear needle jacks and their needles so that the front hooks of the latter will be engaged by the front jacks 23 as these are advanced at position 26. Through the arrangement of recesses in the undersides of the cams 68, 69, and with the lock 71 raised, all of the needles of the rear bed are now transferred to the front bed, as previously described in connection with the individual needles in the design operation. After the second knitting operation has been performed, the front and rear needle jacks follow the courses indicated in the drawings at positions 27 and 40 and the butts of said jacks exit from the lock mechanism without performing a knitting operation at the third knitting position.

Upon the return movement of the lock mechanism from right to left, the lock 83 at position 40 is lowered to its operative position and the vertically adjustable lock 99, similar to the locks 97, 98, is also lowered to an operative position and these two locks cooperate, in the same manner as the locks 63, 97, to advance the rear needle jacks so as to engage with the needle then in the front bed and transfer them to the rear bed at the first knitting position. At the second knitting position, the lock 71 at position 39 is again raised and the lock 98 lowered, and at opposed position 26, the lock 96 is also lowered. Therefore, the front and rear needle jacks are so actuated at the second knitting position as to effect the transfer of the needles from the rear to the front bed. On this movement from right to left, the pivoted locks 29 and 86 at the third knitting position in the front and rear assembly are in the same relative positions of the similar locks 32, 73, at the left-hand end of the lock mechanism. Consequently, the butts of the front and rear needle jacks will not be advanced at the third knitting position and will pass from the lock mechanism without performing a knitting operation.

The apparatus for controlling the operation of the various adjustable locks will now be described. Generally speaking, this apparatus is of a more or less conventional nature and is disclosed sufficiently in Figures 4 and 5 of the drawings to enable those skilled in the art to obtain a full understanding of the operation of the various locks. As illustrated in Figure 4, the lock mechanism includes the front and rear plates generally indicated by the numerals 100 and 101 which are disposed, respectively, above the lock assemblies 21, 22. These plates are joined adjacent their ends by arches 102, 103 so that the two plates which carry the lock assemblies will move in unison as the lock mechanism reciprocates above the needle beds.

For the purpose of controlling the two diagonally sliding locks 28, 33, of the front assembly there is provided a pair of slider bars or sliders 104, 105, the first named of which is shown in plan view in the broken away portion at the lower right-hand corner of Figure 4. These sliders are stepped at their opposite ends and are controlled, in the manner well-known in the art as by mechanism such as illustrated in Patent #2,003,674, dated June 4, 1935, so as to be alternately shifted in opposite directions when the lock mechanism reaches the end of a course of its travel in either direction. The lower slider 105 carries two cams such as the one indicated by the numeral 106 which is in association with lock 28, the other cam cooperating with the lock 33. The lock 28 carries an abutment 107 which is engaged by a leaf spring 108 to normally retain the lock 28 in the position shown in Figures 1 and 2. This position of lock 28, as shown in Figure 4, is attained when the lock mechanism has completed its movement from right to left, at which time, the upper slider 104 is contacted at its left-hand end and moved to the right, which movement results, from the usual geared interconnection of the two sliders, in a corresponding movement of the lower slider 105 to the left. The movement of the slider 105 to the left, at this point, causes the cam 106 associated with the lock 33 to adjust the latter to the position shown at the left of Figures 1 and 2 so as to open the channel 34 and thus permit the butts of the front jacks 23 to exit from the lock mechanism without passing through the knitting position 27 upon the next movement of said mechanism from left to right. Also, the slider 105, moving to the left, permits the lock 28 to restore to the position shown in Figure 4 by reason of the sim-

ilar movement of the cam 106 and pressure of the spring 108.

As best shown in Figure 5, two sliders 104a and 105a are utilized to control the locks 55 and 80 in the same manner in which locks 28, 33 are operated, the sliders 105a carrying cams 106a and each lock being engaged by a leaf spring 108a.

Above the plates 100, 101, two stitch lock-control sliders 109, 110 are mounted for longitudinal movements in the same direction. These two sliders are connected by the usual rocker shaft 111 supported by the arch 103, and the ends of the slider 109 are stepped, like the sliders 104, 105, so that said slider may be shifted longitudinally at predetermined intervals when it is desired to alter the positions of the stitch cams in the front and rear assemblies. Through the rocker shaft connection 111 it will be apparent that when the slider 109, is shifted, a similar movement will be transmitted to the slider 110. Both of these sliders carry the series of cams 112, with each series associated with one of the groups of stitch locks 30, 31, and 64, 72. As best shown in Figure 5, each series of stitch locks has associated therewith a sliding block 113 which is actuated by a pin 114 that is, in turn, operated by one of the cams 112, depending upon the position of the associated slider, to shift the stitch locks to the desired position.

The control of the lock 96 in the front assembly and of the locks 63, 97, at position 38 in the rear assembly, locks 71, 98 at position 39, and locks 83, 99 at position 40, will now be described. All of these locks are under the control of the superposed sliders 115, 116 mounted for longitudinal movements in opposite directions over the front plate 100. The slider 115 carries a guide 117 in which is mounted, for vertical movement, the lock 96 carrying at its upper end a roller 118 adapted to contact with a cam 119 movable with the slider 115 so as to raise the lock 96 or permit the same to drop to its operative position, depending upon the position to which the slider 115 is adjusted at the end of a predetermined movement of the lock mechanism. The movements of the slider 115 are transmitted to the slider 120, positioned over the rear plate 101, through the rocker shaft connection 121 carried by the arch 102. For the control of the two locks 63, 97 at the rear knitting position 38, there is provided a guide 122 (see Figures 3 and 4) in which the two locks are vertically slidable and these two locks carry rollers 123 and 124 respectively. A cam 125 is mounted upon the slider 120 and is engaged by both of the rollers 123, 124. This cam has its effective surface cut, in a manner well-known in the art, so that, depending upon the position of the slider 120, the locks 63, 97, will be raised or lowered to perform their different functions. The control of the locks 71, 98 and 83, 99 is accomplished in the same manner as just described in connection with the locks 63, 97.

The operation of the rear locks 76, 81 will now be described. These locks, as shown in Figure 5, are controlled by the two sliders 126, 127 which, like the other sliders, 104, 105, are movable longitudinally in opposite directions at the end of each course of travel of the lock mechanism so as to alternately advance and retract said locks 76, 81. In order that the movements in opposite directions of the sliders may be accomplished, the same are provided with rack teeth 128, engaged by the gears 129, this being the type of gearing previously referred to for moving the other sliders in opposite directions. The rear edges of the two sliders 126, 127 are provided with recesses 130, 131 which are adapted to be brought into and out of registry with each other by the movements of the sliders. When in registry, as indicated in connection with the lock 76, a leaf spring 132 urges said lock forwardly to advance the abutment 133 of said lock into the registered recesses. When this conditions exists, the recesses 130, 131 associated with the lock 81 are out of registry and the abutment 134 of said lock is forced rearwardly by the edges of the sliders against the tension of the spring 135 of the lock 81. Upon the next adjustment of the sliders 126, 127, the recesses 130, 131 associated with the lock 76 will be out of registry and the similar recesses associated with the lock 81 will be brought into registry with the result that the positions of the two locks will be reversed.

When accomplishing double knitting at two different stages of the operation of the lock mechanism, as hereinbefore described, two different yarns are fed to the needles, one in advance of the other. Heretofore, it has been customary to employ, on the carriage of the lock mechanism, two longitudinally spaced yarn carriers for this purpose and, at the end of each course of travel of said mechanism, the relative positions of these carriers is reversed so that the carrier and its yarn which were leading during the previous movement, again are in advance of the other carrier and yarn on the return movement. In customary practice, this reversal of the yarn carriers does not take place until the advanced carrier, during the movement of the lock mechanism in either direction has passed a distance beyond the edge of the fabric being knitted and, as a consequence, the yarn of said advancing carrier, during said movement beyond said edge and its return movement in the opposite direction at the time of said reversal and before it is again engaged with the needles to start another row of knitting, forms a long, loose loop.

In accordance with the present invention, and as shown in Figures 6 to 8, the formation of these long loops at the edges of the fabric is eliminated and a consequent material saving in the amount of yarn used, is thereby effected. Briefly, this result is attained by a relative longitudinal movement between the two yarn carriers immediately after the advanced carrier has passed an edge of the knitted fabric, which relative movement is produced by stopping said advanced carrier at a point just beyond said edge of the fabric and as soon as its yarn has been acted upon by the last needle at the end of the needle bed, and then continuing to move the following carrier until it reaches a position alongside the first named carrier as indicated in Figure 7.

Referring more specifically to Figures 6 to 8, the movable carriage of the lock mechanism is conventionally indicated at 136, and mounted transversely of said carriage there are three supporting bars 137, 138 and 139 which are arranged above the three guide rails 140, 141 and 142 that extend longitudinally of the machine. Said figures are employed to illustrate the operating conditions when a single, continuous piece of fabric is being knitted and when only two yarn carriers, conventionally shown at 143, 144, are used on opposite sides of the rail 140 to feed the yarns to the needles. In Figure 6, the carriers are shown

in longitudinally spaced relationship, with the carriage 136 moving from left to right. A propelling pin 145 on the crossbar 137, the control of which pin will be hereinafter described in connection with Figures 10 and 11, is lowered to its operative position to engage the carrier 143 and propel it along the rail 140, while a similar pin 146 on the bar 138 likewise engages the carrier 144 mounted on the other side of said rail. In this longitudinally spaced relation, the carriers are moved along by the carriage 136 until the position of Figure 7 is reached at the end of the course of travel of said carriage from left to right. Upon reaching this position, the carrier 143 is first released from its pin 145, by a lifting of the pin in a manner well known and which will later appear, and comes to a stop just beyond the end of the fabric indicated by the dotted line 147. Continued movement of the carriage 136 to the end of its course of travel, then brings the carrier 144 alongside the carrier 143 and the former is then released from its pin 146. Before the carriage starts its return movement, as indicated in Figure 8, the control mechanism (Figures 10 and 11) for the various carrier pins is operated to raise the pin 145 and lower the pin 148 on the bar 139, the pin 146 remaining in its lowered position. Consequently, the pin 148 will first pick up the carrier 143 at its position shown in Figure 7, followed by a pick up of the carrier 144 by the pin 146, and the two carriers will then move along toward the left-hand end of the machine in the relative positions shown in Figure 8. At the termination of said movement, said carriers will again be released in the relative positions of Figure 7 and upon the reversal of the positions of the pins 145 and 148 and return movement of the carriage to the right, the condition illustrated in Figure 6 will again be effected.

In Figure 9, the sequence of operation of the yarn carriers is diagrammatically illustrated for the knitting of a plurality of separate pieces of fabric three of which are indicated by the numerals 149, 150, and 151. In this operation, all three of the guide rails 140, 141 and 142 are employed and a plurality of yarn carriers are mounted on said rails and so arranged for successive and selective operation by the lock mechanism that the open spaces between adjacent edges of the different pieces of fabric will be reduced to a minimum. The lock mechanism carriage 136 is shown in its movement from left to right of the machine and during the knitting of the piece of fabric 149. Under this condition the advanced yarn carrier 143 on the rail 140 is being propelled by the lowered pin 145, while a second yarn carrier 152 on the rail 141, longitudinally spaced from the carrier 143, is being moved along said rail by the lowered pin 153. When the right hand edge of the fabric 149 has been completed the advanced yarn carrier 143 is released, as indicated by the dotted line position between the adjacent edges of the fabrics 149 and 150. At the same time, a lowered pin 154 on the cross-bar 137 picks up a yarn carrier 155 on the rail 142. Continued movement of the carriage 136 brings the carrier 152 to a position opposite the released carrier 143 and at this position said carrier 152 is also released. Concurrently with this latter release, a lowered pin 156 on the bar 138 picks up a carrier 157 mounted on the center rail 141 and moves this carrier along its rail in following relation to the carrier 155 on the rail 142 while the fabric 150 is being knitted. Upon reaching the position between the adjacent edges of the two fabrics 150, 151 the two carriers 155 and 157 are successively released from their respective propelling pins and the lowered pins 145 and 153 are successively engaged with carriers 158 and 159, respectively, so as to propel these carriers to positions just beyond the right-hand edge of the fabric 151 where they are released in the dotted line positions indicated. When the carriage 136 reaches the end of its course of travel the control mechanism of Figures 10 and 11 is operated to raise the propelling pins 145, 154 on the bar 137 and lower the pins 148 and 160 on the bar 139, the pins 153 and 156 remaining in their lowered positions. On the return movement of the carriage to the left, the lowered pin 148 first picks up the carrier 158, followed by engagement of the pin 153 with the carrier 159. Upon completion of the knitting operation on the fabric 151, said two carriers are released at their full line positions between the fabrics 150, 151 and the pins 160 and 156 pick up the two carriers 155 and 157, respectively, which were left at this position during the previous movement of the carriage 136 to the right. The carriers 155 and 157 are dropped at the full line positions between the fabrics 149 and 150 and the carriers 143 and 152 are picked up successively, in a manner now understood, to accomplish the knitting operation on the fabric 149. At the left-hand edge of the fabric 149, the two carriers 143, 152 are released and the carriage then moves on to complete its travel to the left-hand end of the machine where the mechanism of Figures 10 and 11 again operates to reverse the positions of the propelling pins 145, 154 and 148, 160 so that said pins will again assume the positions shown in Figure 9, thus completing a cycle of the operations which occur during a round of travel of the carriage. The pin 161 on the bar 138 is provided in the event that another yarn carrier is utilized to perform an additional operation, said carrier being placed upon the rail 142 on the side thereof opposite the carrier 155.

Referring now to the detailed construction of the yarn control mechanism shown in Figures 10 and 11, this apparatus comprises a supporting beam 162 mounted upon the arches 102, 103 of the movable carriage above the stationary carrier guide rails. The three cross bars 137, 138 and 139 join end and middle castings 163 and 164 forming a part of the beam 162 and, as best shown at the right of Figure 10, said castings carry the vertically disposed sleeve bearings 165 in which the various propelling pins 145, etc., are slidably mounted and normally urged downwardly to their operative positions by springs 166 so as to engage in grooves 167 formed in the upper surfaces of the various yarn carriers. In order to release the yarn carriers from their respective propelling pins so as to stop the carriers at their predetermined positions as described in connection with Figures 6 to 9, the rails 140, 141 and 142 have mounted on opposite sides thereof, and in the path of movement of the carriers, a plurality of pin elevating cams, one of which is indicated at 168 on the rail 140 in association with the carrier 143 and pin 145. Each of these cams 168 is, in accordance with common practice, longitudinally adjustable on its rail and disposed in the path of travel of its propelling pin so that a bevelled portion of the latter will engage said cam and be lifted from the groove 167 against the tension of the spring

166. When so lifted, the associated yarn carrier comes to a stop at the desired position.

The adjustment of the various propelling pins to raised or lowered positions is accomplished through the medium of a plurality of cams which are rotated, as will later appear, to either raise the propelling pins to their inoperative positions or to permit the same to lower under the influence of their springs to their operative positions. One of these cams is associated with each of the propelling pins; thus, the pins 145, 154 have associated therewith, respectively, the cams 169 and 170 mounted on the stub shafts 171, 172 journaled in the castings 163 at the right-hand end of the carriage. Similarly, cams 173, 174 are supported by individual shafts mounted in the castings 163 at the left-hand end of the carriage to control, respectively, the propelling pins 148, 160. Mounted in the middle casting 164 are two separate aligned shafts 175 and 176. The shaft 175 carries two cams 177, 178 associated with the pins 146 and 156; while the shaft 176 carries the cams 179 and 180 for controlling the operations of the pins 153 and 161. The periphery of each cam engages with a roller 181 carried by an extension 182 secured to the upper end of each of the propelling pins so that said pin is lifted when the roller is engaged by high point of the cam and lowered when the roller contacts a low point thereof. The arrangement of the three propelling pins shown in Figure 10 is in accordance with the condition of operation existing in Figure 6. Thus, the cams 169 and 177 have been rotated to permit the pins 145 and 146 to be lowered so as to engage their respective carriers 143, 144, while the cam 173 has been turned to elevate the pin 148. Inasmuch as the pin 146 remains in its operative position at all times, as described in connection with Figures 6 to 8, the cam 177 is cut and positioned relative to its roller 181 so that the partial rotation thereof, which occurs at the end of each course of travel of the carriage, will not effect said pin; whereas, the cams 169 and 173 are cut and positioned relative to their respective rollers to raise or lower the associated pins upon each operation of the cams.

The mechanism for operating the various cams 169, etc., comprises a horizontal plate 183 supported upon the beam 162, and on which is slidably mounted for movement in opposite directions the two sliders 184, 185. Each of the these sliders is formed in two sections extending on opposite sides of the central structure including the cross bar 138, and the two sections of the slider 184 are joined by a rack bar 186, while the two sections of the slider 185 are connected by the rack bar 187. The inner opposed edges of the two sliders are provided with sets of rack teeth 188, 189 engaged, respectively, by pinions 190 and 191 whereby said sliders will move in opposite directions relative to each other whenever one of them is operated at the end of a course of travel of the carriage. In order to vary the amount of movements of the sliders to control the degree of rotation of the various cams 169 etc., the ends of the sliders are stepped, as indicated at 192, to form a plurality of shoulders which are variously engaged by adjustable abutments, well-known in the art, located at opposite ends of the machine. As the sliders are thus moved in opposite directions, rack bars 193 and 194 on the sliders 185, 184 will rotate the gears 195 and 196 on the shafts 171 and 172 so as to control, respectively, the positions of the cams 169 and 170 at the right-hand end of the carriage. The shafts of the cams 173 and 174 at the left-hand end of the carriage have gears 197 and 198 thereon, which are rotated by the racks 199 and 200 on the sliders 185 and 184. At the center position, the shaft 175 carries a gear 201 which engages the rack bar 187 so as to be rotated thereby, while the shaft 176 carries a gear 202 which is rotated by the rack bar 186, and the rotation of these two gears will effect the proper adjustment of the cams 177, 178 and 179, 180 to produce the desired adjustment of the associated propelling pins.

What is claimed is:

1. The method of knitting with a links and links machine including a reciprocating lock mechanism having multiple knitting positions, which comprises shifting certain needles from one bed of the machine to the opposed bed thereof at one of said knitting positions to form loops at said positions during one course of travel of said mechanism, and shifting other needles from one bed to another, during the same course of travel of said mechanism, at a different one of said positions to form other loops at the latter position.

2. The method of knitting with a links and links machine including a reciprocating lock mechanism having multiple knitting positions, which comprises shifting certain needles from one bed of the machine to the opposed bed thereof at one of said knitting positions to form loops at said positions during one course of travel of said mechanism, forming different loops with said needles at another of said positions during said course of travel, and shifting other needles from one bed to another at the latter position and during said same course of travel to form other loops at the last named position.

3. The method of knitting with a links and links machine including a reciprocating lock mechanism having multiple knitting positions, which comprises shifting from one needle bed to another a certain number of needles at one of said positions to form loops thereat during one course of travel of said mechanism, and shifting a different number of needles, during the same course of travel, at another of said positions to form other loops at the latter position.

4. The method of knitting with a links and links machine including a reciprocating lock mechanism having multiple knitting positions, which comprises preselecting certain needles for knitting operations at two of said positions during one course of travel of said mechanism, shifting said needles, at one of said positions, from one needle bed to another to successively form loops at both of said positions, preselecting certain other needles for knitting operations at the other of said two positions, and, during the same course of travel of said mechanism, shifting said other needles from one bed to another at said other position to form loops at the latter position.

5. The method of knitting with a links and links machine including a reciprocating lock mechanism having multiple knitting positions, which comprises, during a single course of travel of said mechanism, shifting a needle from one needle bed to another at one of said positions to form a loop thereat, operating said needle at a second position to form another loop, and shifting a different needle, at said second position, from one bed to the other to form another loop at the latter position.

6. The method of knitting with a links and links machine including a reciprocating lock

mechanism having multiple knitting positions, which comprises shifting a needle from one needle bed to another at one of said positions during one course of travel of said mechanism, and shifting a different needle at another position, during the same course of travel of said mechanism, to form another loop at the last named position.

7. The method of knitting with a movable lock mechanism having multiple knitting positions, which comprises preselecting certain needles for knitting operations at two of said positions and others at one of said positions during a single course of travel of said mechanism by moving jacks of said needles to different stages of advancement relative to said mechanism, operating certain of said jacks at the first of said two positions to transfer associated needles from one needle bed to another to form loops and again operating the latter needles at the second of said positions to form other loops, and operating the other advanced jacks at only the second of said positions to transfer associated needles from one bed to another to form loops at said position.

8. A links and links knitting machine comprising, in combination, opposed needle beds, a reciprocatory lock mechanism cooperating therewith and having a plurality of knitting positions, means to transfer certain needles of the machine from one bed to another at one of said positions during one course of travel of said lock mechanism, and means to transfer other needles from the first to the second mentioned bed at a different knitting position during the same course of travel of said lock mechanism.

9. A links and links knitting machine comprising, in combination, opposed needle beds, a reciprocatory lock mechanism cooperating therewith and having a plurality of knitting positions, means to transfer certain needles of the machine from one bed to another at one of said positions during one course of travel of said lock mechanism, means to again operate said needles at a second knitting position during the same course of travel, and means also operative during said course for transferring other needles from the first to the second mentioned bed at said second position.

MICHAEL ZIMIC.