June 26, 1962 N. LEVIN 3,040,548

METHOD OF KNITTING

Filed Nov. 20, 1959

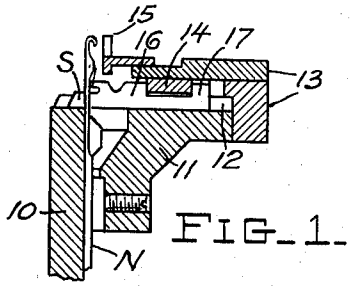



FIG_1_

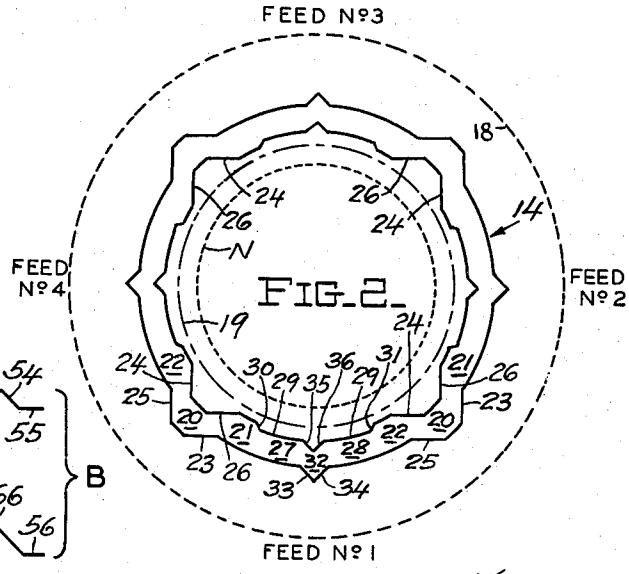
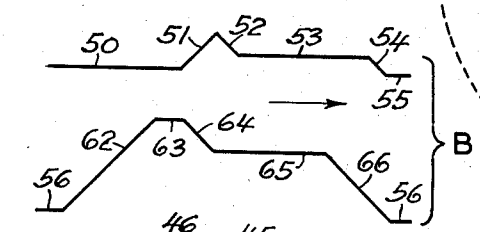



FIG_2_



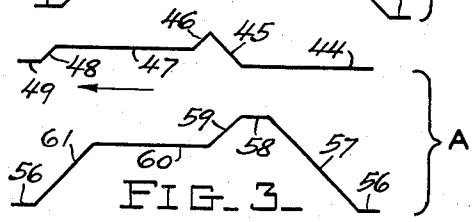




FIG_3_

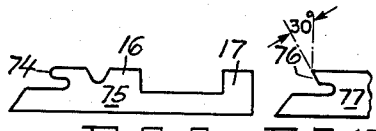



FIG_8_ FIG_10_

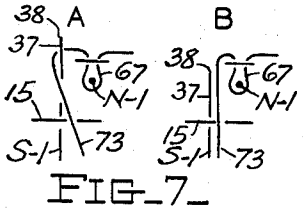



FIG_7_

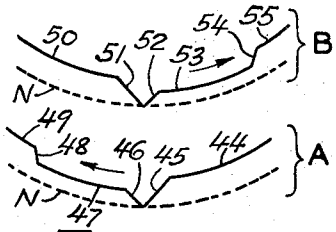



FIG_4_

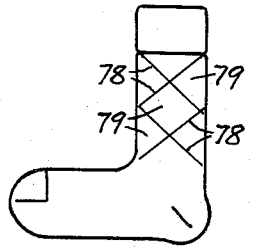
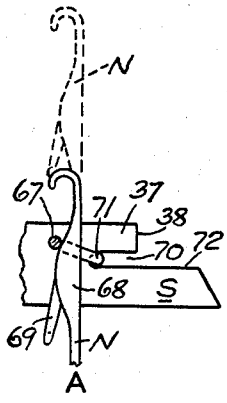
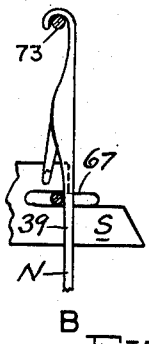
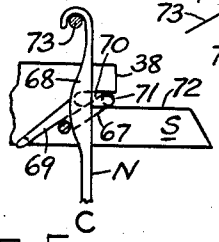



FIG_9_



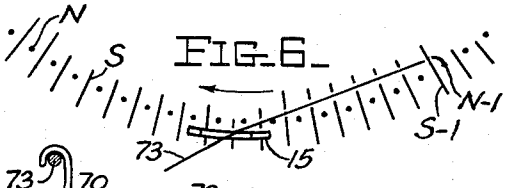




FIG_6_

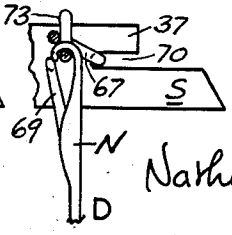



FIG_5_

INVENTOR.

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3,040,548

# METHOD OF KNITTING

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6 Claims. (Cl. 66—43)

The present invention relates generally to a circular independent needle knitting machine and more particularly to a novel method of operating the machine sinkers, in conjunction with the operation of the needles, to provide for an improved or tight suture between adjacent suture joined fabric areas formed by reciprocating knitting on the machine.

It is the primary object of the present invention to provide that the yarn being knit, in each direction of reciprocating knitting, extends directly around the leading needle of the needle group knitting the yarn and is not caught by one or more sinkers of the machine adjacent to the leading needle.

The objects of the invention, including the improved method of knitting and the means therefor, will become apparent from the following detailed description of a preferred form thereof as shown in the accompanying drawings, and from the appended claims.

In the drawings:

FIG. 1 is a sectional view of the needle cylinder, the sinker bed, and the sinker cap of a circular independent needle knitting machine.

FIG. 2 is a plan view of the sinker operating cams of a four feed machine.

FIG. 3 is a schematic view of the paths of travel of the needle hooks and of the sinker noses in each direction of reciprocating knitting at a single feed.

FIG. 4 is a schematic view of the changes in the paths of travel of the sinkers in each direction of reciprocating knitting.

FIG. 5 is a view showing the relative disposition of the sinkers, the needles, and the stitches on the latter, at several places around the machine.

FIG. 6 is a schematic view of the knitting elements and of a yarn in one stroke of reciprocating knitting.

FIG. 7 is a schematic view showing later positions of one of the sinkers and needles of FIG. 6.

FIG. 8 is a view showing a modified form of sinker nose.

FIG. 9 is a view of a hose wherein the tight suture made by the present invention is particularly useful.

FIG. 10 is a view showing another modified form of sinker nose.

This invention is intended to free the yarn from entrapment by the sinkers adjacent to the leading needles of groups of needles in each stroke of reciprocating knitting. When the yarn is caught by the sinkers, a rather loose stitch construction is formed by the leading needles, and when solid color areas (formed by reciprocating knitting on groups of needles) are suture joined, the suture line is of relatively open formation. Particularly in a hose, FIG. 9, of the argyle type, it is desirable that the sutures **78**, **78** be of tight construction in securing the diamond shaped areas **79**, **79** together.

In a multi-feed circular knitting machine, such as the four feed Reading CK machine, the needle cylinder and sinker bed (and the needles and sinkers therein) are movable for rotary and reciprocating knitting while the needle and sinker operating cams are stationary. The sinker cams remain in the same fixed position during movements of the needle cylinder and sinker bed in each direction of reciprocating knitting.

In FIG. 1, the needle cylinder is shown at **10** with the usual circular series of independently movable latch needles N therein, and the sinker bed is shown at **11**, fast to the cylinder **10** with the usual circular series of independently movable sinkers S in slots **12** thereof. The sinker cap **13**, which is held in fixed position by any convenient means, is provided on its under face with sinker actuating cams **14** and on its upper face with a throat plate **15**, centrally disposed at each of the feeds, for directing yarns to the needles. The rear of each sinker S is cut out to provide the front and rear spaced butt portions **16** and **17**, respectively, between which the sinker cam **14** is disposed in order to engage these butts and to move these sinkers in both directions of radial movement relative to the needle circle.



The generally circularly shaped sinker cam **14** is shown in plan view in FIG. 2 with the sinker cap outlined by the dot dash circles **18** and **19**, and the needle circle indicated at N. Inasmuch as the sinker cam shape is duplicated at each of the four feeds, a description of the sinker cam portion and the method of knitting at one of the feeds, say feed No. 1, will suffice for all feeds of the machine. The portions **20** of the sinker cam, each disposed above a stitch cam of the machine to act in conjunction therewith, serve to withdraw the sinkers after stitch forming movement of the needles by the stitch cams and also serve to return the sinkers to their innermost positions, the latter positions being that provided by the full width adjacent cam portions **21**, **22** of the sinker cam **14**, A and D of FIG. 5. The sinkers are at their innermost positions to hold the stitches down when the needles are rising to clear the stitches from their latches, A of FIG. 5, and when the needles are descending in stitch drawing movement to draw the yarn over the sinker noses, D of FIG. 5.

In the reverse (clockwise in FIG. 2) movement of the machine, the action of portion **20**, to the right of feed No. 1, is such that its rear face **23** engages the rear sinker butts **17** and withdraws the sinkers while its front face **24** engages the front sinker butts **16** to return them to their innermost positions at cam portion **22**. In the forward (counterclockwise in FIG. 2) movement of the machine, the action of portion **20**, to the left of feed No. 1, is such that its rear face **25** engages the rear sinker butts **17** and withdraws the sinkers while its front face **26** engages the front sinker butts **16** to return them to their innermost positions at cam portion **21**. The portions **27** and **28** of the cam, between and adjacent the portions **21** and **22**, are undercut along their inner faces as at **29**, **29** and are joined to the inner faces of portions **21** and **22** by the cam faces **30** and **31**, respectively. The cam portion **32**, between portions **27**, **28**, is provided with a projection on the outer side thereof having cam faces **33** and **34**, and is undercut on its inner side to provide cam faces **35** and **36** which lead into the faces **29**, **29**. The outer faces of cam portions **21**, **22**, **27**, and **28**, are in circular alignment.

During the forward stroke of the machine, the sinkers approaching feed No. 1 from the left hand side thereof, FIG. 2, are in their innermost positions as they pass cam portion **21**, having been so moved by cam face **26**. As they travel along cam portion **27**, the sinkers remain in such innermost position, the cam faces **29** and **30** having no effect upon them. At cam portion **32**, cam face **33** engages rear sinker butts **17** to withdraw the sinkers (though not necessarily to the same extent as the outward movements caused by cam portion **20**) to the position shown in FIG. 1 and at B in FIG. 5, the opening between the inner cam faces **35**, **36** permitting such withdrawal. It should be noted that cam portion **32** is centrally disposed at each of the feeds and is accordingly located under the centrally disposed throat plates **15** at each of the feeds. In this position of the sinkers, the sinker nose **37** is disposed so that its front vertical edge **38** is in the vicinity of shanks **39** of the needles N, here shown at about their mid-points. The position of nose

edges 38 in relation to the needle shanks may vary to some extent and still function to release a yarn caught thereunder. After passing cam face 33 the sinkers are caused to move inward by the engagement of cam face 36 with their front sinker butts 16, the extent of this movement being such that the sinkers are not moved to their full innermost positions but only to a mid-position between their innermost and outermost positions, this sinker position being shown at C in FIG. 5. The sinkers continue in this mid-position along cam portion 28 until their front butts 16 meet cam face 31 at which time the sinkers are once again moved to their innermost postions, D in FIG. 5. Continued movement of the sinkers causes them to pass along a cam section 20 in the manner set forth.

In the reverse stroke of the machine, the sinkers approaching feed No. 1 from the right hand side thereof, FIG. 2, are in their innermost positions as they pass cam portion 22, having been so moved by the cam face 24. The movement of the sinkers is generally reversely similar to their movement during the forward stroke of the machine, being in innermost position as they pass cam portion 28, being withdrawn by cam face 34 of cam portion 32, being partially moved inwardly by cam face 35, traveling along cam portion 27 in their mid-position, and being fully moved inwardly by cam face 30 of cam portion 21, after which they pass along a cam portion 20 in the manner set forth.

It will be noted that during the forward stroke, the sinkers are in innermost position while passing cam portions 21 and 27, are withdrawn at cam portion 32, are in mid-position while passing cam portion 28, and are in innermost position at cam portion 22, whereas, during the reverse stroke, the sinkers are in innermost position while passing cam portions 22 and 28, are withdrawn at cam portion 32, are in mid-position while passing cam portion 27, and are in innermost position at cam portion 21. This sinker movement is schematically shown in FIG. 4 wherein A represents the reverse stroke and B represents the forward stroke of the machine. A portion of the needle circle N is shown in relation to the paths of travel of sinker noses 38, wherein at A, the sinkers are fully in along line 44, as moved by cam face 24, are withdrawn along line 45, as moved by cam face 34, are partially moved in along line 46, as moved by cam face 35, continue partially moved in along line 47, and are fully moved in along line 48, as moved by cam face 30, to innermost position along line 49. At B, the forward stroke, the sinkers are fully in along line 50, as moved by cam face 26, are withdrawn along the line 51, as moved by cam face 33, are partially moved in along line 52, as moved by cam face 36, continue partially moved in along line 53, and are fully in along line 54, as moved by cam face 31, to innermost position along line 55.

In FIG. 3 the relationship of the sinker and needle movements is schematically shown in order to describe the sinker action as it relates to the stitch action of the needles. Generally the sinkers and the needles move in different circular paths and in order to relate their movements, their paths of travel have been distorted to show their movements as being along straight lines in a single flat plane in FIG. 3. The characters applied to the circular path of the sinker noses in FIG. 4 have been applied to the straight line path of FIG. 3. The path of movement of the needle hooks is shown, in the reverse stroke A, as commencing at 56, where the needles are at their lower level at which time the sinkers are in their innermost position along line 44, then the needles are raised along line 57 to their uppermost position at 58 to clear the needle latches with the sinkers still in along line 44 (moving upwards as in A of FIG. 5 to the dotted line needle position), then the needles move downwardly along line 59 to tuck level 60 as the sinkers are retracted along line 45 (to the relative position B of FIG. 5), then the needles travel at this tuck level along line 60 with the sinkers along line 47 after moving partially inwardly along line 46, then the needles travel downwardly in stitch forming movement along the line 61 as the sinkers are moved inwardly along line 48 so that before the needles reach stitch forming level 56 (under the stitch cam) the sinkers are in their innermost position along line 49 (one stage of this co-ordinated movement being at C in FIG. 5). The paths of movement of needles and sinkers in the forward stroke B of FIG. 3 is reversely similar to the reverse stroke, with the sinkers in innermost position along line 50 as the needles move from lowermost level 56 upwardly along line 62 to latch clearing level 63, then the sinkers are retracted along line 51 as the needles move down along line 64, the sinkers are moved along line 52 to and to remain at their mid-positions along line 53 as the needles travel along tuck level line 65, and, as the needles move along line 66 to stitch forming level 56, the sinkers are moved inwardly along line 54 to innermost position 55. It should be noted that the final movement of the sinkers along lines 48 and 54 is such that the sinkers reach their innermost positions while the needles are still moving down along the lines 61 and 66.

As may be seen at A in FIG. 5, as each needle N moves upwardly, stitches 67 move downwardly thereon and it is desirable to have the sinkers in innermost positions at this time to hold the stitches down and keep them from being raised with the needle as the wider cheek portions 68 of the needles pass through the stitches, in order that the stitches 67 may be cleared from and drop off latches 69 as the needles move to their fully raised positions, as shown in dotted lines. The stitches 67 are held down by the action of throats 70 of the sinkers in engagement with the sinker wale portions 71 of the yarn forming these stitches. The stitches through which the stitches 67 were drawn have not been shown. The position of the sinkers is such that the stitches are held rather firmly against the needles. Thereafter the sinkers are withdrawn along lines 45, 51, which leaves the stitches around the needle shanks with the sinker wale portions 71 of the yarn on the ledges 72 of the sinkers.

In this type of machine, stitches are drawn over the sinker noses so that the sinkers should be in their innermost positions when the needle hooks form new stitches of yarn 73 thereover. Final inward movement of the sinkers takes place as the needles are moving downwardly, C of FIG. 5, for as the needles descend, along lines 61, 66, the stitches 67 move upwardly along the cheeks 68 of the needles preparatory to closing the latches and being cast off over the needle hooks, as new stitches are formed of the yarn 73. This downward movement of the needles causes the cheeks 68, being wider than the shanks, to urge the stitches 67 downwardly to some extent before passing over the cheeks so that the sinker wale yarn 71 is accordingly urged downwardly onto the ledge 72 of the sinker, and the sinkers may now be safely moved to their innermost positions without danger of the yarn 71 being cut or otherwise damaged by the vertical nose portions edges 38 of the sinker noses 37 as the throats 70 move in over the yarn. Thus the needles act to draw down the stitches sufficiently to permit the re-entry of the sinkers without damage to the sinker wale portions of the yarn. Thus by the time that the needle hook draws the yarn 73 over nose 37, to draw a new stitch through the stitch 67, the sinker is safely in its stitch drawing position with the sinker wale 71 within the throat 70 of the sinkers without damage thereto.

The reason for withdrawing the sinkers is to release the yarn normally caught by the sinker noses during reciprocating knitting on this type of knitting machine. As may be seen in FIG. 6, during a reverse stroke, with reference to a needle N–1, which was the last needle to knit on the preceding forward stroke of the machine, as the needles start to rise, along line 57, the sinkers are in innermost position along line 44, to hold down the stitches. The yarn 73, which extends from throat plate 15 to the stitch 67 on needle N–1, is caught under the

nose of at least sinker S–1 on the near side of needle N–1, as the sinkers are moved inwardly by cam face **24**. It may be thus caught by other sinkers between the sinker S–1 and the throat plate **15**. As the needle N–1 and sinker S–1 move toward the throat plate **15** along sinker cam portion **28**, the yarn **73** is still caught by the sinker nose, and if not released, will reach the throat plate in the relation shown in FIG. 7 at A. However cam face **34** acts to withdraw the sinkers so that sinker S–1 is in the position B of FIG. 7 at the throat plate with the result that yarn **73** has been released by sinker S–1 and extends directly from stitch **67** to the throat plate. Since the throat plate level is higher than that of the sinkers, the yarn remains free of further entrapment by the sinkers for the remainder of the stroke. Thus when the reverse course is knit on this stroke at this feed, commencing on a first needle adjacent the needle N–1, or on the needle N–1 itself, the yarn **73** will be wrapped directly around such needle and a tight stitch will be formed, to accordingly form a tight stitch for the suture line.

During forward strokes the yarn **73** is similarly normally caught by a sinker following the last needle to knit in the reverse strokes, and is similarly freed therefrom. In this manner tight stitches are formed by the leading needles at each end of the needle groups forming courses of the fabric sections at each of the feeds during reciprocating knitting with the result that these tight stitches form tight sutures joining the fabric sections. At the same time the re-entry of the sinkers is accomplished without cutting the yarn forming the sinker wales of the fabric.

In FIGS. 8 and 10 modified forms of sinker noses are shown to further reduce the possibility of cutting the sinker wale yarn when the sinkers are re-introduced to stitch forming position. The nose edge **38** of sinker S is vertically disposed, whereas the nose edge **74** of sinker **75** is rounded, and the nose edge **76** of sinker **77** is rearwardly and downwardly tapered at a suitable angle, for example, the thirty degree angle shown.

Once the sinkers have been withdrawn at cam portion **32**, they may remain so withdrawn until they reach the cam portions **21**, **22**, by further reducing the width of the cam portions **27**, **28** so that the entire re-entry movement of the sinkers is accomplished by accordingly longer cam faces at **30** and **31**. This will eliminate the cam faces **35**, **36**. The construction of FIG. 2 is preferred for the reason that it provides wider cam portions at **27** and **28**, since the partial return of the sinkers to mid-position does not interfere with the knitting once the yarn has been freed from the sinkers.

The sinkers may be retracted at cam portion **32** and fully reinserted at this portion of the sinker cam **14** to their innermost positions, providing some provision is made to eliminate cutting of the sinker wales during such re-entry movement of the sinkers. One method of eliminating the cutting is to provide the special nose shapes to the sinkers as shown in FIG. 8 wherein the yarn will be pushed to one side of the nose without cutting the same. Another method may be the provision of a sufficient take up action on the fabric of the hose to cause the sinker wales of the fabric to be drawn downwardly onto the sinker ledges so that the sinker noses will pass safely thereover without cutting the same. However, in both of these cases, the yarn will be free of the sinkers and the tight initial stitches will be formed.

The yarn is not cut when the sinkers move in along faces **24** and **26** of cam portion **20** for the reason that the needles are at their low levels at this time, under a stitch cam, and hold the stitches down so that the throat of the sinker passes over the yarn of the sinker wales. The yarn is not cut when the sinkers move in along cam faces **30** and **31** for the reason that at this time the needles are descending and are lowering the stitches by the action of their cheek portions.



I claim:

1. The method of operating the circle of latch needles and the circle of sinkers of a movable cylinder circular knitting machine having fixed sinker operating cams wherein stitches of a yarn are drawn by the needles over the upper edges of horizontally disposed sinker noses and wherein the lower edges of said noses form the upper edges of the stitch holding throats of the sinkers, including, in each stroke of reciprocating knitting upon a group of needles, the step of moving the sinkers inwardly of the needle circle to positions wherein their throats act to hold down the stitches then on the group of needles while the latter is being raised to latch clearing level, the step of moving the sinkers outwardly of the needle circle a distance sufficient to free the yarn from the noses of sinkers adjacent the last needle to knit the yarn in the preceding knitting stroke, and the step of moving the sinkers to their first mentioned positions for the next stitch drawing movement of the needles.

2. The method of operating the circle of latch needles and the circle of sinkers of a movable cylinder circular knitting machine having fixed sinker operating cams wherein stitches of a yarn are drawn over the upper edges of horizontally disposed sinker noses and wherein the lower edges of said noses form the upper sides of the stitch holding throats of the sinkers, including, in each stroke of reciprocating knitting upon a group of needles, the step of moving the sinkers inwardly of the needle circle to their normal positions wherein their throats act to hold down the stitches then on the group of needles while the latter is being raised to latch clearing level, the step of moving the sinkers outwardly of the needle circle a distance sufficient to free the yarn from the noses of sinkers adjacent the last needle to knit the yarn in the preceding knitting stroke, and the step of moving the sinkers to their first mentioned positions as said stitches are passing over the cheeks of their needles as the latter are being lowered during their next stitch forming movement.

3. The method of operating the circle of latch needles and the circle of sinkers of a movable cylinder circular knitting machine having fixed sinker operating cams wherein stitches of a yarn are drawn over the upper edges of horizontally disposed sinker noses and wherein the lower edges of said noses form the upper sides of the stitch holding throats of the sinkers, including, in each stroke of reciprocating knitting upon a group of needles, the step of moving the sinkers inwardly of the needle circle to their normal positions wherein their throats act to hold down the stitches then on the group of needles while the latter is being raised to latch clearing level, the step of moving the sinkers outwardly of the needle circle a distance sufficient to free the yarn from the noses of sinkers adjacent the last needle to knit the yarn in the preceding knitting stroke, and the step of moving the sinkers to their first mentioned positions as said stitches are being urged downwardly by their needles as the latter are being lowered during their next stitch forming movement.

4. The method of operating the circle of latch needles and the circle of sinkers of a movable cylinder circular knitting machine having fixed sinker operating cams wherein stitches of a yarn are drawn by the needles over the upper edges of horizontally disposed sinker noses and wherein the lower edges of said noses form the upper sides of the stitch holding throats of the sinkers, including, in each stroke of reciprocating knitting upon a group of needles, the step of moving the sinkers inwardly of the needle circle to their normal positions wherein their throats act to hold down the stitches then on the group of needles while the latter is being raised to latch clearing level, while the group of needles is being lowered to tuck level the step of moving the sinkers outwardly of the needle circle a distance sufficient to free the yarn from the noses of sinkers adjacent the last needle to knit the yarn in the preceding knitting stroke, and the step of mov-

ing the sinkers to their first mentioned positions while the group of needles is being lowered from the tuck level to the stitch forming level during the next stitch forming movement thereof.

5. The method of operating the circle of latch needles and the circle of sinkers of a movable cylinder circular knitting machine having fixed sinker operating cams wherein stitches of a yarn are drawn by the needles over the upper edges of horizontally disposed sinker noses and wherein the lower edges of said noses form the upper sides of the stitch holding throats of the sinkers, including, in each stroke of reciprocating knitting upon a group of needles, the step of moving the sinkers inwardly of the needle circle to their normal positions wherein their throats act to hold down the stitches then on the group of needles while the latter is being raised to latch clearing level, the step of lowering the group of needles to tuck level, the step of moving the sinkers outwardly of the needle circle a distance sufficient to free the yarn from the nose of the sinker next adjacent to the last needle to knit the yarn in the preceding knitting stroke, and the step of moving the sinkers to their first mentioned positions while the group of needles is being lowered from the tuck level to the stitch forming level during the next stitch forming movement thereof.

6. The method of operating the circle of latch needles and the circle of sinkers of a movable cylinder circular knitting machine having fixed sinker operating cams wherein stitches of a yarn are drawn by the needles over the upper edges of horizontally disposed sinker noses and wherein the lower edges of said noses form the upper sides of the stitch holding throats of the sinkers, including, in each stroke of reciprocating knitting upon a group of needles, the step of moving the sinkers inwardly of the needle circle so that their throats are disposed within the same to hold down the stitches then on the group of needles while the latter is being raised to latch clearing level, the step of moving the sinkers outwardly of the needle circle so that their noses are disposed in the vicinity of the needle shanks to free the yarn from the noses of sinkers adjacent the last needle to knit the yarn in the preceding knitting stroke, and the step of moving the sinkers to their first mentioned positions as said stitches are urged downwardly as they pass over the cheeks of their needles as the latter are being lowered during their next stitch forming movement.



**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 460,502 | Davis | Sept. 29, 1891 |
| 2,360,668 | Fregeolle | Oct. 17, 1944 |
| 2,398,785 | Grothey | Apr. 23, 1946 |