Jan. 8, 1963 A. F. CRATER 3,071,947

SINKER OPERATING MECHANISM AND METHOD OF KNITTING

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FIG. 1

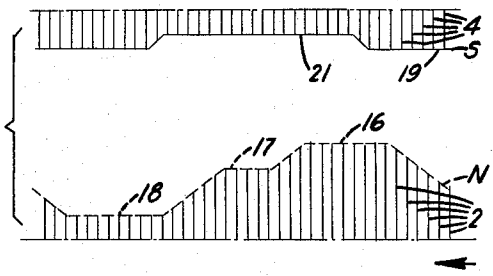


FIG. 3

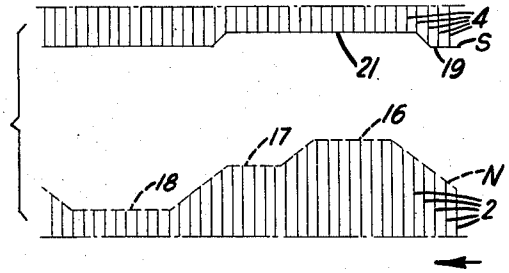


FIG. 2

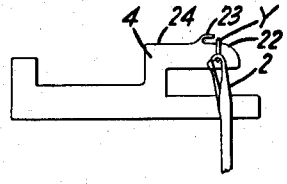


FIG. 4

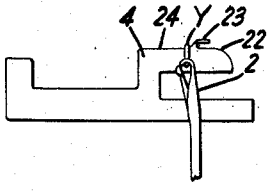
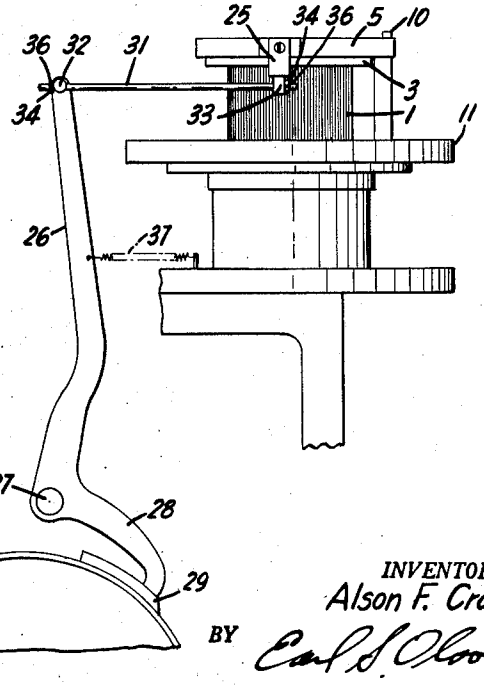


FIG. 5



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FIG. 6

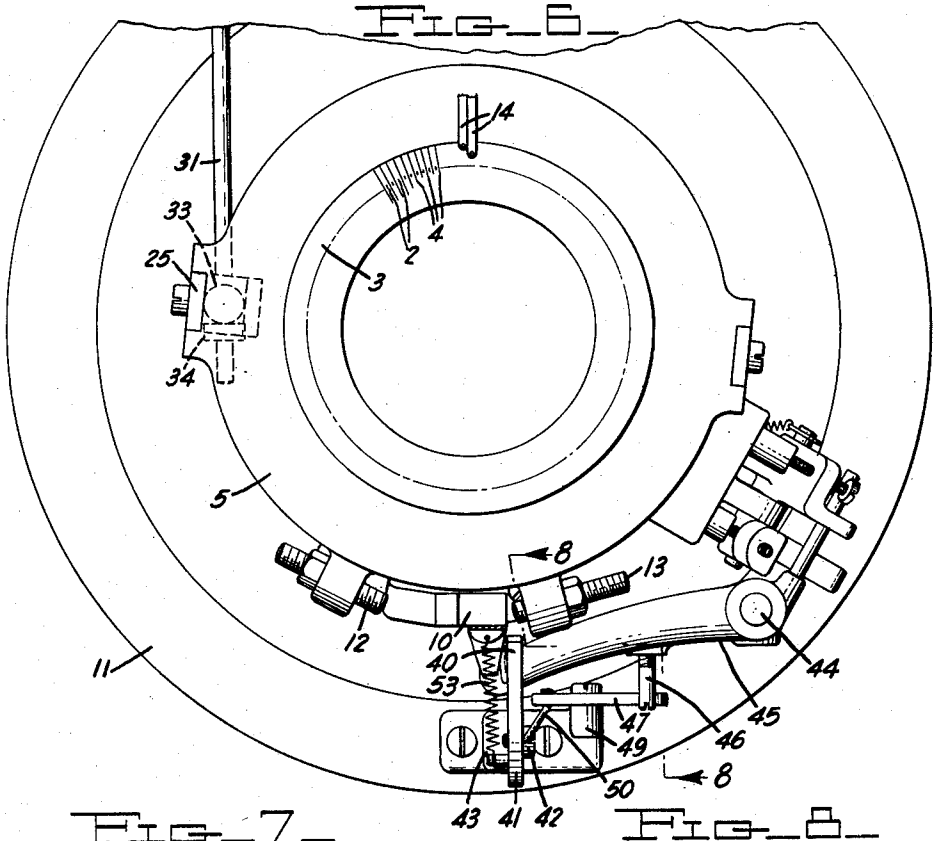


FIG. 7

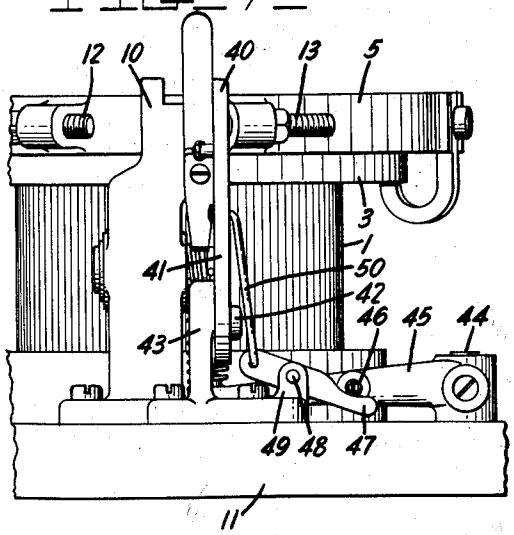
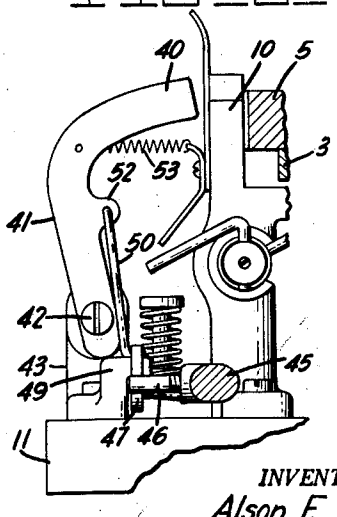


FIG. 8



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3,071,947

SINKER OPERATING MECHANISM AND METHOD OF KNITTING

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Filed Mar. 16, 1960, Ser. No. 15,423
7 Claims. (Cl. 66—107)

The instant invention relates to improvements in circular knitting machines and particularly in machines adapted for knitting fine gauge women's hosiery and to a method of knitting thereon.

In the normal operation followed for many years in the knitting of fabrics on such machines the yarn is drawn to form the stitch loops over the noses of the sinkers, this method having proved quite satisfactory in the production of relatively coarse gauge fabrics such as men's hosiery and the like. This conventional method of loop drawing has not, however, proved equally as effective in the knitting of sheer fabric such as women's nylon hosiery for which generally a 400 needle machine employing yarn as fine as 15 denier or less is used. The problem lies in the difficulty of obtaining uniform loop structure by the conventional method, the lack of uniformity in this respect, unobservable for all practical purposes in the coarser gauge goods, showing up in the form of streaks or other defects in the sheerer goods.

Heretofore it has been known for the purpose of obtaining a clearer stitch and more uniform fabric to modify the operation, specifically the sinker operation, of the machine to employ portions of the backs of the nebs of the sinkers rather than the noses or platforms thereof in the stitch drawing function. The resulting method of knitting has been quite effective in obtaining uniformity of loop size and in otherwise overcoming the disadvantages of the regular method of knitting but at the same time has required the substitution of a special sinker cap embodying a "flopper" cam constituting a portion of the cam track for the sinkers, the flopper cam being movable between positions in which it in part defines the usual cam track and in part in which it defines a special cam track for imparting an earlier forward movement of the sinkers to position them for taking the yarn behind their nebs. The movement of the flopper cam between the two positions is needed as it has been found that the regular method of drawing stitches must still be used in the knitting of the heel and toe and in the make-up courses. The required additional mechanism, which has also included linkage extending between the flopper cam and a lever adapted to be contacted by a special cam on the main pattern drum of the machine to move the flopper cam between its different positions at the required time, has added substantially to the cost of the machine and particularly has proved expensive in the conversion of existing machines. Also operational difficulties occur at times in the shifting of the flopper cam.

The principal object of the instant invention is the provision of an improved and simplified modification of a conventional circular knitting machine to enable the machine to operate in both methods of stitch drawing with means for shifting from one to the other under pattern control.

Another object of the invention is the provision of means for this purpose which eliminates the necessity of changing the sinker cap or other normal operating elements of the machine.

Briefly stated the invention resides in part in the utilization of a present characteristic of circular knitting machines, namely, the shiftability of the sinker cap thereof, and more particularly resides in the incorporation in such

machine of means under pattern control to shift the sinker cap and hence the sinker cams at certain times during the knitting cycle. The sinker cap is shifted by the added means in a clockwise direction, that is, in a direction opposed to the direction of rotation of the cylinder during the formation of rotary knit or run-down fabric to alter the relationship between the paths of the sinkers and needles to an extent that the sinkers are advanced at the time the yarn is laid and the stitches or loops are drawn in the back of the sinker nebs in a manner similar to that accomplished by the known method employing a flopper cam, hereinabove referred to. As is well known in the conventional operation of circular knitting machines shifting of the sinker cap occurs when the direction of rotation of the needle cylinder is changed as in reciprocating knitting, the extent of shifting being controlled by bumper screws on the sinker cap adapted to contact a stop carried in a fixed position. For the purpose of the instant invention the extent of shifting of the sinker cap in a clockwise direction is greater than normally allowed by the bumper screw and stop and hence the bumper screw controlling such shifting must be backed off farther than usual. On the other hand when the machine goes into reciprocating knitting with the stitches drawn as is conventional over the platforms or noses of the sinkers the sinker cap must be retained in its usual position. To enable the sinker cap to function as required a supplementary stop is employed in accordance with the instant invention, the stop being movable under pattern control into a position between the conventional stop and the bumper screw during reciprocating knitting.

My invention will be more fully understood and further objects and advantages will become apparent when reference is made to the more detailed description which is to follow and to the accompanying drawings in which:

FIGURE 1 is a diagrammatic view illustrating the paths of movements of the needles and sinkers during normal operation of a circular knitting machine;

FIG. 2 is a detail view illustrating the position of a sinker and needle during stitch drawing operations with the sinker and needle paths in the relative positions of FIG. 1;

FIG. 3 is a view similar to FIG. 1 illustrating the relative positions of the sinker and needle paths upon the shifting of the sinker cap to perform knitting operations in accordance with the instant invention;

FIG. 4 is a view similar to FIG. 2 illustrating the positions of a needle and sinker during the drawing of a stitch with the sinker and needle paths in the relative positions illustrated in FIG. 3;

FIG. 5 is a diagrammatic elevational view of a circular knitting machine with parts omitted and disclosing the sinker cap shifting means of the instant invention;

FIG. 6 is a plan view of a circular knitting machine disclosing features of the instant invention incorporated therein;

FIG. 7 is a front elevational view of a portion of the machine of FIG. 6; and

FIG. 8 is a sectional view taken on a line 8—8 of FIG. 6.

Referring now to the drawings my invention is disclosed as incorporated in a circular knitting machine of a conventional type such as a Scott & Williams Model K machine adapted for the manufacture of women's sheer hosiery, e.g. 400 needle seamless nylon hosiery. It will be understood however that the invention may be incorporated in circular knitting machines of other makes and types.

Machines of the type referred to are well known and only such parts have been illustrated in the drawings and

will be described hereinafter as are necessary to an understanding of the invention. The machine includes a rotatable slotted needle cylinder **1** containing the usual latch needles **2** defining a circle of needles, the needles being adapted for vertical movements at one or more yarn feeding and knitting stations between latch clearing, yarn taking and stitch drawing positions by suitable cams (not shown). The machine also includes a slotted sinker ring **3** mounted adjacent the upper end of the needle cylinder for rotation therewith, the sinker ring carrying a circle of sinkers **4** mounted in the slots thereof and adapted for movements in the slots between advanced and retracted positions under the control of sinker cams (not shown) carried by a sinker cap **5**. The sinker cap is mounted on the sinker ring and adapted to be frictionally engaged thereby for movement therewith to the extent permitted by a stop **10**, mounted in fixed position on a non-rotatable base or platform **11**, and by adjustable bumper screws **12** and **13** carried by the sinker cap. In the normal operation of the machine in rotary or run-down knitting such as employed for the leg of a stocking the needle cylinder and sinker ring are rotated together in a counterclockwise direction, the sinker ring carrying the sinker cap therewith until its bumper screw **12** contacts stop **10**, the sinker cap thereafter remaining stationary during the continuation of knitting.

The relative paths of the needles and sinkers at the knitting station or stations during such normal circular knitting is illustrated in FIG. 1 by the lines N and S, respectively. As there shown the needles **2**, which are moving in the direction indicated by the arrow, follow the path N in which they are first raised to a maximum or latch clearing height **16** at which the previously formed fabric loops held thereby are brought below the latches thereof. They are then, as they approach the knitting station, partially lowered to yarn taking level **17** at which level the yarn Y is fed thereto as by a yarn feed finger **14** the needles thereafter being lowered to their lowest position **18** while performing their stitch drawing and knitting functions. With the sinker cap positioned for normal operation by contact of the bumper screw **12** with the stop **10** the sinkers move through their path S from an advanced position **19**, i.e. one in which they are projected toward the center of the needle cylinder, thence as they approach the knitting station and suitably while the needles are at their latch clearing height, to a retracted position **21** in which they are retained during the yarn feeding and stitch drawing operations whereby the yarn is laid and the stitches are drawn over the noses or platforms **22** and in front of the nebs **23** of the sinkers as illustrated in FIG. 2. Following movement of the needles to their lowest position **18** the sinkers are again advanced to their position **19** to catch and hold the new stitches in the throats thereof as the needles are raised to position **16**.

When the stocking leg is completed the machine is clutched into reciprocatory operation and auxiliary knitting cams are brought into operation whereby the needles move through their stitch drawing and knitting waves during strokes in both directions of reciprocation. As the needle cylinder reverses direction in the successive strokes the sinker cap is shifted through its frictonal contact with the sinker ring between positions as determined by the bumper screws **12** and **13** and stop **10** to maintain the relative sinker and needle paths, i.e., to cause the stitches to be drawn over the noses of the sinkers (FIG. 2) in both directions of knitting.

For the purposes of the instant invention the sinkers are of the type having a flat portion **24** behind the neb **23** at substantially the height of, or slightly higher than, the nose or platform **22** as shown for example in patent to Fregeolle No. 2,374,857 issued May 1, 1945 which describes the known method of knitting behind the sinker nebs previously referred to. In the present method during the operation of the machine for making a circular fabric, for example in the knitting of the leg with the exception of the make-up courses, which are preferably knit in a conventional manner over the noses of the sinkers, the position of the sinker cap **5** is shifted in a clockwise direction so that the relative positions of the sinker and needle paths, S and N respectively, are as illustrated in FIG. 3. Thus in the shifted position of the cap the sinkers are moved from their retracted positions **21** to their fully advanced position before the stitches are drawn by the needles **2** whereby the stitch drawing occurs behind the nebs **23** of the sinkers as illustrated in FIG. 4. In other words a similar knitting procedure is followed as in the known method of knitting behind the sinker nebs previously described.

For the purpose of shifting the sinker cap in the clockwise direction at the desired times the additional mechanism illustrated particularly in FIG. 5 is employed. This mechanism comprises a lug **25** secured to the sinker cap and a lever **26** pivoted as at **27** to a fixed portion of the machine, the lever including an arm **28** having a downwardly projecting end adapted to ride on and off cams **29** on a conventional pattern drum **30** of the machine. The upper end of lever **26** and lug **25** are connected by a link **31** the ends of which are suitably passed through bores formed in a pin **32** rotatably carried in the upper end of lever **26** and the projecting end **33** of lug **25**. Collars **34** are mounted on the ends of the link whereby they may be adjustably positioned to actively control the effective length of the link, the collars being maintained in their adjusted position as by set screws **36**. A tension spring **37** is connected at one end to lever **26** above the pivot point **27** and at its other end to a fixed portion of the machine, the spring urging the upper end of the lever to the right as viewed in FIG. 5.

As will be apparent when, during counterclockwise rotation of the needle cylinder and sinker ring, drum **30** is shogged to bring a cam **29** on the pattern drum beneath the end of arm **28** the upper end of lever **26** is swung to the left as viewed in FIG. 5 to, through the medium of link **31**, shift the sinker cap in a clockwise direction against the frictional drag of the sinker ring and the tension of spring **37** and maintain it in such position as long as the end of arm **28** rides on the cam. When arm **28** rides off the cam the tension of spring **37** swings the upper end of lever **26** to the right and permits the sinker cap to be rotated through its frictional contact with the sinker ring until bumper screw **12** again contacts stop **10**.

Inasmuch as the shifting of the sinker cap as described above to bring about the relationship between the paths of the sinkers and needles illustrated in FIG. 3 requires an abnormal movement of the sinker cap in a clockwise direction bumper screw **13** must be backed off from the position in which it is normally set. However during reciprocatory knitting the cap must still be prevented from rotating in a clockwise direction during a reverse stroke to an extent beyond that permitted by the conventional setting of the bumper screw. In order to provide for the latter, without requiring constant adjustment of the bumper screw as the machine shifts between rotary and reciprocatory operations, an auxiliary stop **40** is employed for insertion against the stop **10** and between it and bumper screw **13** when the machine is shifted to reciprocatory operation, the auxiliary stop being of a width equal to the distance that the screw is backed off from its normal setting. Auxiliary stop **40** suitably comprises the inwardly projecting end of a lever **41** pivoted at **42** to a member **43** secured to the platform **11**. The movement of the auxiliary stop **40** into an operative position between the stop **10** and bumper screw **13** and away therefrom can be controlled by suitable auxiliary linkage and levers similar to that illustrated at **26** and **31** but preferably, to avoid the inclusion of such additional mechanism, means presently on circular knitting ma-

chines of the type referred to is adapted to this purpose. Thus similar knitting machines of the type described have what is termed a gravity rod **44** mounted for vertical movements under the control of the main pattern drum and normally employed for shifting certain cams and droppers into and out of operation in preparation for reciprocatory knitting and at the end of reciprocatory knitting respectively, all as disclosed in patent to Page et al. No. 1,841,205 issued January 12, 1932 to which reference may be made for details of construction and operation. As disclosed in said patent and in the instant application gravity rod **44** has secured thereto at its upper end a lever **45** serving when the rod is moved upwardly to move the dropper pick into operative position for reciprocatory knitting. For the purposes of the instant invention arm **45** is also used to control the positioning of auxiliary stop **40**. Thus arm **45** is provided with a laterally extending pin **46** for contact with one arm of a lever **47** pivoted as at **48** to a lug **49** supported from the ring **11**. The arm of lever **47** on the other side of the pivot **48** is connected by a link **50** to an ear **52** extending inwardly from the lever **41** above the pivot **42** thereof. A tension spring **53** with its ends secured to the lever and a fixed part of the machine tends to bias lever **41** to position stop **40** between stop **10** and bumper screw **13**. As will be understood, upon upward movement of gravity rod **44** in preparation for reciprocatory knitting, pin **46** moves upwardly permitting lever **47** to swing on its pivot and lever **41** to swing toward the machine under the influence of spring **53** to operatively position auxiliary stop **40** between stop **10** and bumper screw **13**. Upon the return of the machine to circular knitting gravity rod **44** is moved downwardly to move the cams and widening picks it controls out of operation such downward movement at the same time depressing the end of lever **47** and, in turn, causing arm **41** to swing outwardly on its pivot **42** and move the auxiliary stop **40** to an inoperative position.

In the knitting of a stocking fabric in accordance with the instant invention the make-up courses are suitably knitted with the machine in normal operation, that is, with arm **28** of lever **26** off of cam **29** whereby the sinker cap is in its usual position with bumper screw **12** against stop **10**, the relative positions of the needles and sinkers being that disclosed in FIG. 1. Upon completion of the makeup courses the pattern drum is shogged to cause arm **28** to ride upon a cam **29** with the result that the sinker cap is shifted in a clockwise direction until the sinker and needle paths have the relationship illustrated in FIG. 3 and the loops are drawn behind the nebs of the sinkers as illustrated in FIG. 4. This operation is continued until the heel is reached at which time the pattern drum is again shogged to move cam **29** out from under arm **28** and permit arm **26** to swing to the right as illustrated in FIG. 5 under the influence of spring **37** whereby the sinker cap, due to its frictional contact with the sinker ring is shifted in a counterclockwise direction until bumper screw **12** is again brought against stop **10**. During the circular knitting, gravity rod **44** has been maintained in its lowered position in which it holds the end of lever **47** depressed and, through link **50** and arm **41**, the auxiliary stop **40** inoperative. At the time the machine is clutched into reciprocatory motion gravity rod **44** is raised allowing lever arm **47** to swing on its pivot and arm **41** to be swung inwardly by tension spring **53** whereby auxiliary stop **40** is placed in operative position between bumper screw **13** and stop **10**. Reciprocatory knitting then proceeds during the formation of the heel. Upon completion of the heel the rod **44** is moved to its lowered position to move the auxiliary stop **40** to inoperative position and a second cam **29** on the pattern drum is moved beneath arm **28** on lever **26** to again shift the sinker cap clockwise to resume knitting over the backs of the sinkers during the formation of the foot of the stocking. Upon reaching the toe, arm **28** rides off the cam and the sinker cap is allowed to shift to the right to bring bumper screw **12** against stop **10** and auxiliary stop **40** is again inserted between stop **10** and bumper screw **13** to prepare, as before, for reciprocatory knitting.

Having thus described my invention in rather complete detail it will be understood that these details need not be strictly adhered to and that various changes and modifications may be made all falling within the scope of the invention as defined by the following claims.

I claim:

1. In a circular knitting machine including a rotatable circle of needles, a rotatable sinker ring, sinkers having nebs mounted therein for advancing movements toward and retracting movements away from the center of the needle circle, a shiftable sinker cap including means for causing said advancing and retracting movements of the sinkers, a stitch drawing station and means for feeding yarn to said needles and sinkers thereat, the improvement comprising means for shifting said sinker cap to and holding it in a position in which said sinker advancing and retracting means maintain said sinkers in a retracted position during the stitch drawing operation upon rotary movement of said circle of needles and said stitches are drawn forwardly of said sinker nebs, and additional means for shifting said sinker cap to and holding it in a position in which said sinker advancing and retracting means maintain said sinkers in their advanced position during said stitch drawing operation upon rotary movement of said circle of needles and said stitches are drawn rearwardly of the sinker nebs.

2. In a circular knitting machine as defined in claim 1, pattern operated means for controlling the operation of said additional sinker cap shifting and holding means.

3. In a circular knitting machine as defined in claim 1, in which said additional sinker cap shifting and holding means includes a pattern drum, a lever operated by said drum, a member secured to said sinker cap, and means connecting said lever to said member.

4. In a circular knitting machine as defined in claim 1, in which said circle of needles is adapted for both rotary and reciprocatory movements and said machine includes cooperating stop means for limiting the extent of shifting of said sinker cap during said rotary and reciprocatory movements, the further improvement comprising means for modifying the operation of said stop means when said sinker cap is in said position to which it is shifted and held by said additional means.

5. In a circular knitting machine as defined in claim 4, in which said cooperating stop means comprises a fixed stop, and auxiliary stop, and adjustable members on said sinker cap, one of said adjustable members for contact with said fixed stop and the other of said adjustable members for contract with said auxiliary stop, and said modifying means comprises pattern controlled means for moving said auxiliary stop between an inoperative position and an operative position for contact with said other adjustable member.

6. The method of knitting on a circular knitting machine adapted for rotary operation for run-down knitting and for reciprocatory operation for reciprocatory knitting, said machine having a circle of needles, a sinker ring, sinkers having nebs mounted in said sinker ring for advancing and retracting movements toward and away from the center of the needle circle, a shiftable sinker cap including means at a fixed location relative thereto for causing said advancing and retracting movements of the sinkers, a stitch drawing station and means for feeding yarn to the sinkers thereat, the steps comprising positioning said sinker cap to cause said sinker advancing and retracting means to advance said sinkers at said stitch drawing station to cause the stitches to be drawn behind the nebs thereof during rotary operation, knitting a fabric section, shifting said cap to cause said sinker advancing and retracting means to retract said sinkers at said stitch

drawing station to cause the stitches to be drawn in front of the nebs thereof during rotary operation, and knitting a fabric section.

7. A method as defined in claim 6 including the further step of positioning said sinker cap to cause said sinker advancing and retracting means to advance said sinkers at said stitch drawing station to cause the stitches

to be drawn in front of the nebs of the sinkers during reciprocatory operation.

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2,913,886 Kale et al. ---------- Nov. 24, 1959