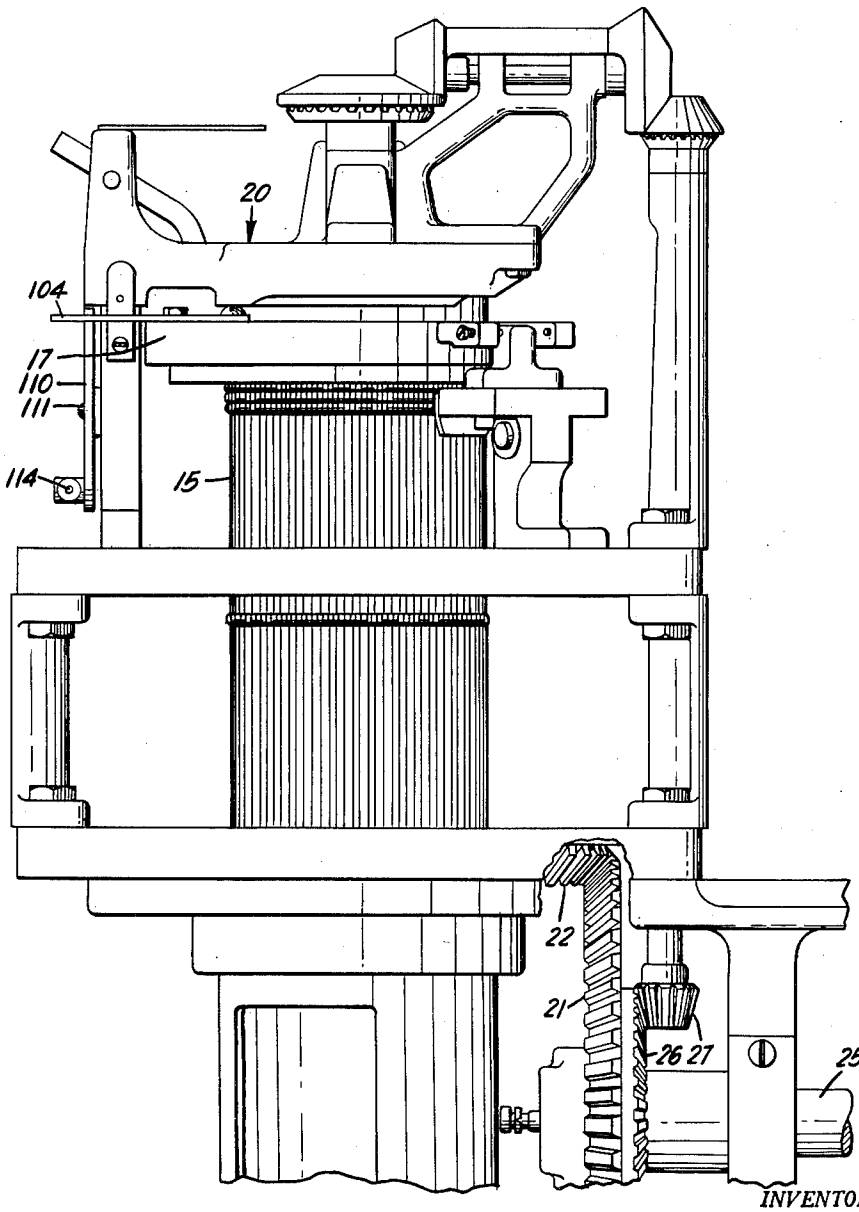
July 3, 1962 H. E. CRAWFORD 3,041,860

MEANS FOR AND METHOD OF OPERATING THE SINKERS OF KNITTING MACHINES

Filed April 30, 1959 4 Sheets-Sheet 1

Fig. 1



INVENTOR.
Herman E. Crawford
BY
Earl B. Olson
ATTORNEY

July 3, 1962 H. E. CRAWFORD 3,041,860

MEANS FOR AND METHOD OF OPERATING THE SINKERS OF KNITTING MACHINES

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Fig. 2

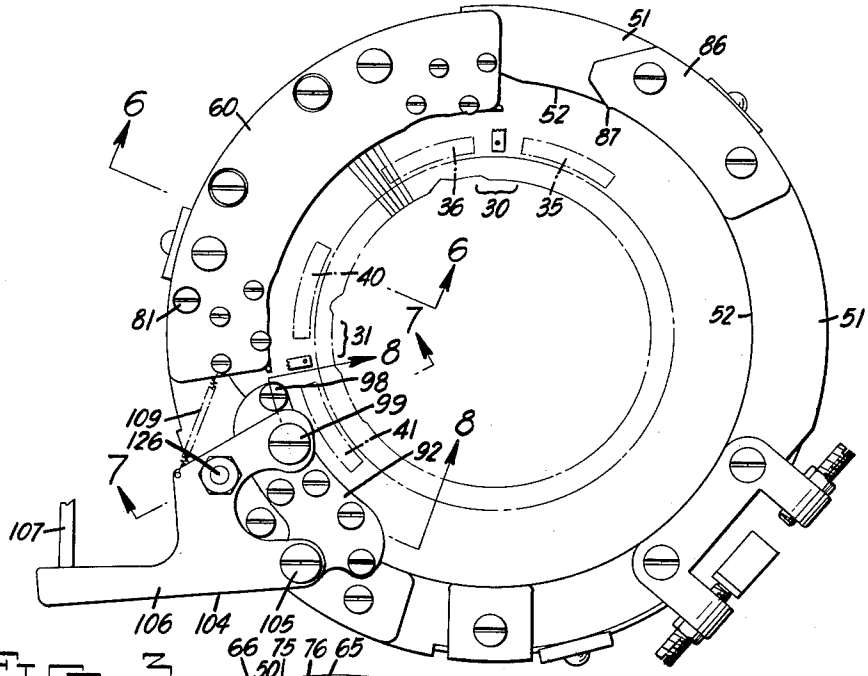


Fig. 3

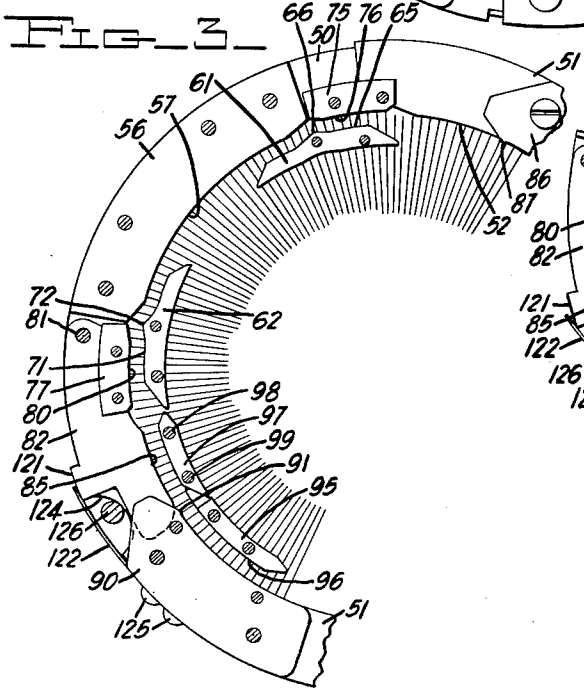
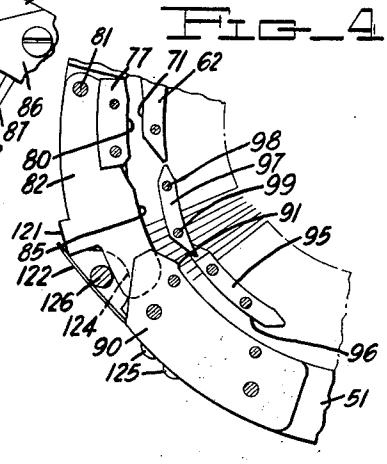


Fig. 4



INVENTOR.
Herman E. Crawford
BY
Carl N. Olson
ATTORNEY

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MEANS FOR AND METHOD OF OPERATING THE SINKERS OF KNITTING MACHINES

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Fig. 5

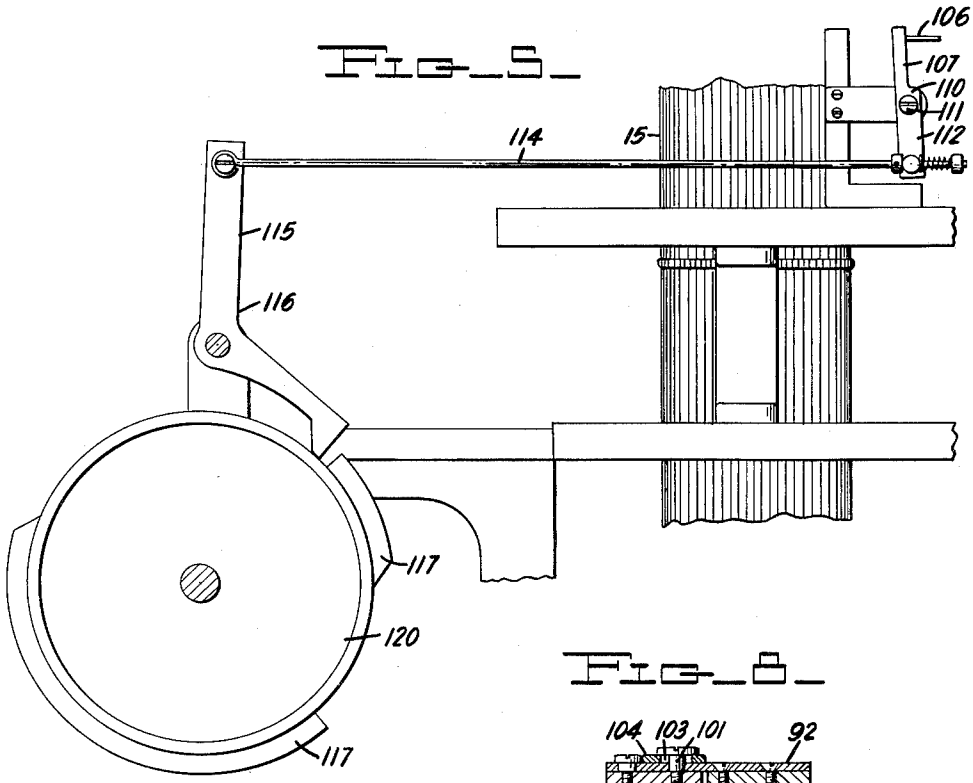


Fig. 8

Fig. 6

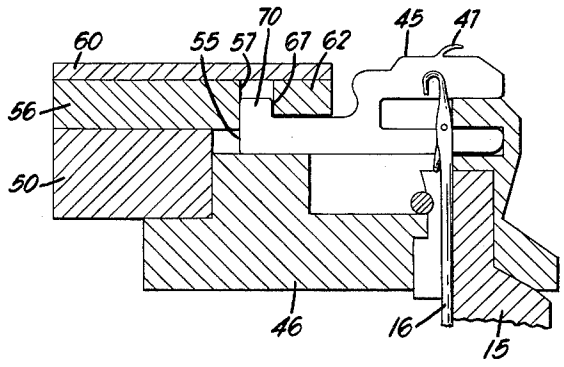
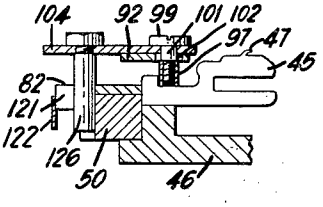


Fig. 7



INVENTOR.
Herman E. Crawford
BY Carl J. Olson
ATTORNEY

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MEANS FOR AND METHOD OF OPERATING THE SINKERS OF KNITTING MACHINES

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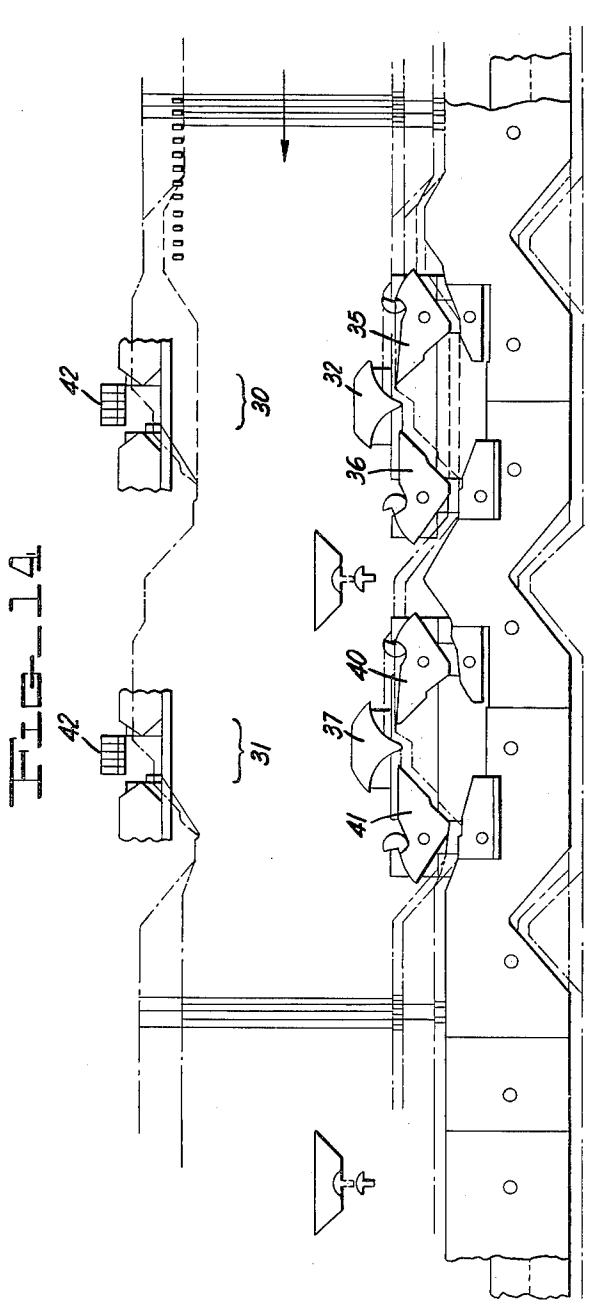


Fig. 14

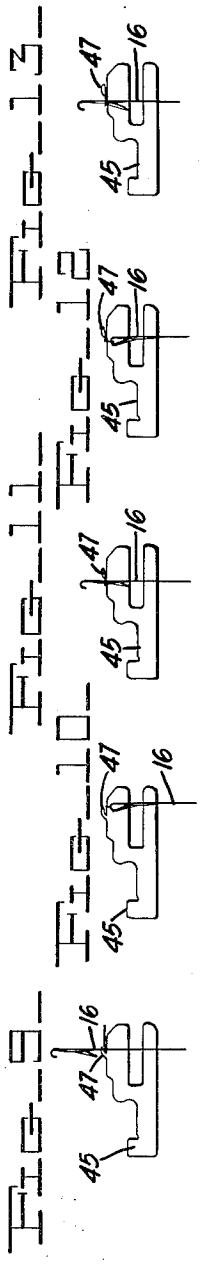


Fig. 13

Fig. 12

Fig. 11

Fig. 10

Fig. 9

INVENTOR.
Herman E. Crawford
BY
Carl S. Olson
ATTORNEY

United States Patent Office

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MEANS FOR AND METHOD OF OPERATING THE SINKERS OF KNITTING MACHINES

Herman E. Crawford, Kernersville, N.C., assignor to The H. E. Crawford Company, Incorporated, Kernersville, N.C., a corporation of North Carolina

Filed Apr. 30, 1959, Ser. No. 810,125

8 Claims. (Cl. 66—108)

This invention relates to circular knitting machines and more particularly to means for and a method of operating the sinkers of such machines having a multiplicity of knitting stations which are operative during both rotary and reciprocatory movements of the machine in forming different portions of tubular stocking fabrics.

In circular knitting machines and particularly such machines for making seamless ladies' stockings, the needles and sinkers are commonly operated to form yarns into stitches in front of the neb portions of the sinkers at a single knitting station during both rotary and reciprocatory operations of the machines. In attempts to increase the productivity of the machines, yarns were simultaneously fed at two knitting stations and the needles and sinkers were operated in the same manner to form the yarns into stitches at each of the stations. This method of two-feed knitting produced good quality fabric and greatly reduced the operating time necessary to knit those portions of the stockings formed during rotary operation of the machine. However, in producing the heel and toe portions of the stocking which are formed during reciprocatory operation of the machine, the yarn extending between the yarn feeding means and the last active needle to knit at the leading knitting station in each direction of knitting had a tendency to be caught in the throats of the sinkers at the trailing knitting station. When this happened the yarn was idly kinked around the inactive needles as they passed through the trailing knitting station which very often caused the yarn to be broken or severed. Therefore, while it was feasible to form the rotary or rundown portions of the stockings at both knitting stations by the two-feed method, the reciprocatorily knit portions of the stockings were formed only at one of the knitting stations. Hence, such multifeed machines adapted for knitting ladies' stockings found only limited use.

It is therefore an object of the invention to provide means in a circular knitting machine of the type adapted for multifeed knitting for overcoming the above mentioned and other difficulties occurring in the production of ladies' stockings on such machines.

Another object of the invention is the provision of means in a multifeed circular knitting machine for changing the operation of the sinkers during the formation of fabric portions knitted by rotary and reciprocatory operation of the machine.

A still further object of the invention is the provision of means in a two-feed circular knitting machine for operating the sinkers through different paths at each of the knitting stations during reciprocatory operation of the machine in one direction and for reversing the operating relation of the sinkers at the two feeds during reciprocatory operation of the machine in the opposite direction.

A still further object of the invention is the provision of an improved method of operating the sinkers of a multifeed circular knitting machine whereby the sinkers are caused to follow different paths at the different feeds in forming fabric portions during reciprocatory operation of the machine.

Another object of the invention is the provision of an improved method of operating the sinkers of a multifeed circular knitting machine whereby the sinkers are operated along the same path at each of the feeds in forming fabric portions during rotary operation of the machine, and the sinkers are operated along different paths at the different feeds in forming fabric portions during reciprocatory operation of the machine.

With these and other objects in view which will become apparent from the following detailed description of the illustrative embodiment of the invention shown in the accompanying drawings, the invention resides in the novel elements, features of construction and cooperation of parts, as hereinafter more particularly pointed out in the claims.

In the drawings:

FIGURE 1 is an elevational view of a portion of a circular knitting machine having mechanism according to the invention incorporated therein;

FIG. 2 is a top plan view on an enlarged scale of the sinkerhead of the machine shown in FIG. 1;

FIG. 3 is a view of a portion of FIG. 2 with certain of the parts being omitted;

FIG. 4 is a view of a portion of FIG. 3 but with certain of the parts being in different positions relative to FIG. 3;

FIG. 5 is an elevational view on a reduced scale of certain of the control mechanism of the machine as seen from the left of FIG. 1;

FIG. 6 is a cross-sectional view on an enlarged scale taken along the line 6—6 of FIG. 2;

FIG. 7 is a cross-sectional view on an enlarged scale taken along the line 7—7 of FIG. 2;

FIG. 8 is a cross-sectional view on an enlarged scale taken along the line 8—8 of FIG. 2;

FIGS. 9 to 13 are views showing the relation of the needles and sinkers during different phases of the stitch drawing operation in accordance with the invention; and

FIG. 14 is a developed view of the need operating cams and yarn feeding means of the machine as viewed when looking outwardly from the interior of the needle cylinder.

Referring to FIG. 1 of the drawings there is shown a portion of a circular knitting machine of the type shown and described in my Patent No. 2,861,440, issued November 25, 1958 for knitting tubular stockings, the machine including a needle cylinder **15** having slots for pivoted latch needles **16** (FIG. 6), a sinker mechanism **17** and a transfer dial indicated generally at **20** having usual transfer bits (not shown). The needle cylinder **15** is adapted for rotary movement in forming the welt, leg and foot portions of the stockings and for reciprocatory movement to form heel and toe portions of the stockings. Both rotary and reciprocatory movements are transmitted to the needle cylinder **15** through a bevel gear **21** which is in meshing engagement with a bevel gear **22** on the needle cylinder. The bevel gear **21** is carried on a drive shaft **25** and the gear **21** carries a bevel gear **26** having meshing engagement with a bevel gear **27** which forms a part of the usual driving means for operating the dial **20** and transfer bits in timed relation to the needle cylinder in forming turned welt portions on the stockings.

The machine of said Patent No. 2,861,440 is adapted for two-feed knitting and is provided with a main knitting station and a second or auxiliary knitting station indicated generally at **30** and **31**, respectively (FIG. 14). At knitting station **30** there is provided cams for operating the needles including a center cam **32**, a right stitch cam **35** and a left stitch cam **36**. Knitting station **31** includes a center cam **37**, a right stitch cam **40** and a left stitch cam **41**. The cams at the two knitting stations are identical and operate the needles through stitch drawing movements during both rotary and reciprocatory movement of the needle cylinder **15**. Each knitting station is provided with yarn feeding means indicated at **42** and narrowing and widening picks for fashioning the heel and toe portions of the stockings. The sinker mechanism **17** includes sinkers **45** which are mounted for radial sliding movements in slots in a sinker ring or bed **46** secured to

the needle cylinder 15 for rotation therewith. The sinkers are operated in timed relation to the needles 16 at each of the knitting stations 30 and 31 by means of and in a manner hereinafter set forth.

During rotary movement of the needle cylinder 15 the needles 16 and sinkers 45 are operated at each knitting station to draw stitches in front of neb portions 47 of the sinkers in a usual manner. However, in accordance with the instant invention, during reciprocatory movements of the needle cylinder in opposite directions, the sinkers 45 are operated so that the needles draw the stitches in front of the nebs 47 at one of the knitting stations and in back of the nebs at the other of the knitting station during each reciprocatory movement. For so operating the sinkers during both rotary and reciprocatory movements of the needle cylinder 15 the sinker mechanism 17 includes sinker cam ring 50 (FIG. 6) which is mounted in the sinker bed 46 for oscillating movement concentrically of the needle cylinder in a common manner. Secured to the cam ring 50 is a cam plate 51 (FIGS. 2 and 3) having an inner camming surface 52 for engaging rear edges 55 of the sinkers 45 and a cam plate 56 having an inner camming surface 57.

Mounted on the cam plate 56 and secured therewith to the cam ring 50 is a plate 60 (FIGS. 2 and 6) having a cam block 61 fixed to the underside thereof adjacent to the knitting station 30 and a cam block 62 also fixed to the underside thereof adjacent to the knitting station 31. The cam block 61 has an outer camming surface 65 and a high portion 66 for engaging inner surfaces 67 of butt portions 70 of the sinkers 45. The cam block 62 is provided with an outer camming surface 71 and a high portion 72 for engaging the inner surfaces 67 of the sinkers. As shown in FIG. 3, camming surface 65 is at the leading side of the cam block 61 with respect to the forward or counterclockwise movement of the needle cylinder 15 and the camming surface 71 is at the leading side of cam block 62 with respect to the reverse or clockwise direction of movement of the needle cylinder. Also fixed to the underside of the plate 60 adjacent to the right end of the cam plate 56 is a cam block 75 having an inner surface 76 facing the cam surface 65 of the block 61 and a similar cam block 77, having an inner surface 80 facing the cam surface 71 of the block 62, is secured to the underside of the plate adjacent to the left end of cam plate 56.

Pivotally mounted on the cam ring 50 adjacent to the knitting station 31 by means of a stud or bolt 81 is a cam plate 82 having an inner camming surface 85 (FIGS. 3 and 4). The cam plate 82 is adapted to be moved from an inner position in which the camming surface lies concentric to the center of the needle cylinder 15 as shown in FIG. 3 to an outer position, shown in FIG. 4, by means of and for purposes hereinafter set forth. Mounted on the cam plate 51 adjacent to the stitch cam 35 at knitting station 30 is a cam plate 86 having a high camming surface 87 and a similar cam plate 90 having a high camming surface 91 is mounted on the cam plate 51 adjacent to the stitch cam 41 at the knitting station 31. The camming surface 87 of plate 86 and the camming surface 91 of plate 90 are positioned in relation to the stitch cams 35 and 41, respectively, to operate the sinkers 45 in a manner hereinafter set forth.

A plate 92 secured to the cam plate 90 has a cam block 95 fixed to the underside thereof (FIG. 8) inwardly of the cam plate, the cam block 95 having an outer arcuate surface 96 lying concentric to the center of the needle cylinder (FIG. 3). One end of a second cam block 97 is pivoted to the underside of the plate 92 by means of a stud 98. The cam block 97 is adapted to be moved from an inner position, shown in FIG. 3, to an outer position, shown in FIG. 4, the cam block in the latter position acting on the surfaces 67 of the butt portions 70 of the sinkers for purposes hereinafter set forth.

For moving the cam block 97 between its inner and outer positions the cam block threadably carries a stud 99 having a shouldered portion 101 extending through a slot 102 in the plate 92 and a slot 103 in a lever 104 (FIGS. 7 and 8). The lever 104 is pivotally mounted on a stud 105 secured in fixed position in the plate 92. The slot 102 in the plate 92 and the slot 103 in the lever 104 extend at substantially right angles relative to each other to permit free movement of the stud 99 in the plate and lever during movements of the stud by the lever. For moving the lever 104 which movement is in turn transmitted to the cam block 97, the lever is provided with arm 106 for engagement with one arm 107 of a lever 110 (FIGS. 1, 2 and 5). A spring 109 (FIG. 2) connected between the lever 104 and a fixed part of the sinker mechanism biases the lever 104 and cam 97 to the inner position of FIG. 3 and maintains the arms 106 and 107 in resilient engagement. Lever 110 is pivotally mounted on a stud 111 and a second arm 112 of the lever is resiliently connected by means of a rod 114 to one arm 115 of a pivotally mounted pattern lever 116. Pattern lever 116 is adapted to be operated by cam blocks 117 on a pattern drum 120 which forms a part of the pattern mechanism of the machine. When no cam block 117 is beneath the lever 116 the lever 104 and cam block 97 are moved to and held in the inner position of FIG. 3 by the spring 109 and engagement of a cam block beneath the lever 116 moves the cam block to the outer position of FIG. 4.

As hereinbefore set forth, the cam plate is also movable between its inner and outer positions shown in FIGS. 3 and 4. Normally during reciprocatory knitting the cam plate 82 is in its inner position of FIG. 3, this position of the cam plate being determined by engagement of a downwardly extending flange 121 on the cam plate with the outer periphery of the cam ring 50. The flange 121 is held in engagement with the cam ring by the free end of a flat spring plate 122 which is secured by screws 125 to the outer periphery of the cam ring. A pin carried in the lever 104 is adapted to engage and release the spring plate 122 from engagement with the flange 121 when the lever is operated to move the cam block 97 to its outer position and at this time the cam plate 82 is free to be moved to its outer position by the butt portions 70 of the sinkers 45 as the sinkers engage and are moved outwardly by the cam block 97. The pin 126 is adapted to engage the bottom surface of a notch 124 formed in the cam ring 50 to limit the movement of the lever 104 and cam 97 to their inner positions.

Prior to the start of a portion of the stocking fabric which is formed during rotary operation of the machine, a cam 117 on the pattern drum 120 is moved beneath the lever 116 which acts to move the lever 104 counterclockwise, as viewed in FIG. 2, to move the cam block 97 to its outer position of FIG. 4. As the needle cylinder 15 is rotated in the forward or counterclockwise direction as viewed in FIG. 2 and in the direction of the arrow as viewed in FIG. 14, the needles 16 are raised to latch clearing level to pass above the right stitch cam 35 at the knitting station 30 in the manner set forth in said Patent No. 2,861,440. As the cylinder 15 continues to rotate needles 16 engage and are lowered by the center cam 32 to receive yarn from the yarn feeding means 42. At this time the butts 70 of the sinkers 45 engage the surface 65 of cam block 61 to move the sinkers outwardly to the position of FIG. 9 in which the tips of the neb portions 47 project slightly through the needles 16. Upon continued rotation of the needle cylinder, the sinkers 45 engage high portion 66 and are moved outwardly to the position of FIG. 10 to fully withdraw the nebs 47 beyond the needles and the needles engage and are lowered by the left stitch cam 36 to engage the yarn and draw stitches in front of the nebs in a common manner. During continued rotation of the needle cylinder, the sinkers are moved inwardly by the camming surface 57 of the cam plate 56 to place the neb portions 47 above the newly drawn stitches (FIG. 11) to

hold them as the needles are again raised to latch clearing level and to pass above the right stitch cam 40 at the knitting station 31. As the needle cylinder continues to rotate, the needles 16 are lowered by the center cam 37 to take yarn at the knitting station 31, and the sinkers are moved outwardly by the cam block 97 to withdraw the neb portions 47 beyond the circle of needles so that the needles as they are lowered by the left stitch cam 41 draw their stitches in front of the neb portions of the sinkers. The sinkers are then moved inwardly to place the neb portions above the stitches by the camming surface 91 of the cam plate 90 and remain in such position until the needles are again raised to the latch clearing level at the knitting station 30.

Prior to the first reciprocatory movement of the needle cylinder 15 to form the heel and toe portions of the stockings which is also in the forward or counterclockwise direction, the lever 116 rides off of a cam 117 and the lever 104 is moved clockwise to its position of FIG. 2 to move the cam block 97 to its inner position and the cam plate 82 is moved to its inner position by the spring plate 122 as shown in FIG. 3. Also at this time the needles are selected into active and inactive groups in the manner set forth in said Patent No. 2,861,440, the narrowing and widening picks are actuated and the other machine adjustments are made incidental to the formation of the heel and toe. As the needle cylinder makes its first forward or counterclockwise movement, the active needles and sinkers are operated at the knitting station 30 to draw stitches in front of the neb portions of the sinkers in the manner hereinbefore set forth. During continued movement of the cylinder, the needles, as they pass through the knitting cams of the knitting station 31, are raised to latch clearing level and are then lowered by the center cam 37 to take yarn at this station and the sinkers engage and are moved inwardly by the camming surface 85 of the cam plate 82 (FIG. 11). The neb portions of the sinkers are at this time in substantially the same position as during their stitch holding position. Hence, as the needles are lowered by the left stitch cam 41, the stitches are drawn over the sinkers in back of the neb portions thereof, as shown in FIG. 12. As the needle cylinder continues to move in the forward direction the sinkers engage and are given a further inward movement by the camming surface 91 of the cam plate 90 to apply tension on the newly drawn stitches as the needles are raised through the stitches preparatory to the reverse or clockwise reciprocatory movement of the needle cylinder.

As the needle cylinder starts its reverse movement, the active needles are raised to latch clearing level and to pass above the left stitch cam 41 and are then lowered by the center cam 37 to take yarn at the knitting station 31. As the needles are lowered by the right stitch cam 40, the sinkers are moved outwardly by the camming surface 71 and high portion 72 of the cam block 62 so that the stitches are drawn in front of the neb portions of the sinkers. During continued movement of the needle cylinder, the sinkers are moved inwardly by the camming surface 57 of the cam plate 56 to place the neb portions above the newly drawn stitches to hold them as the needles are raised to latch clearing level and to pass above the left stitch cam 36 at the knitting station 30. With the sinkers 45 in their inner stitch holding position the length of yarn extending between the yarn feeding means at the knitting station 31 and the last needle of the active group of needles to take yarn at this station lies in back of the nebs of the sinkers.

During continued movement of the needle cylinder 15 in the reverse direction, the active needles are lowered by the center cam 32 at the knitting station 30 and are then lowered by the right stitch cam to take yarn at this station, and to form it into stitches. At this time the camming surface 52 of the cam plate 51 maintains the sinkers in their stitch holding position and the stitches are drawn in back of the neb portions 47 thereof. As the needle cylinder continues to move in the reverse direction, the sinkers

are given a further inward movement by the camming surface 87 of the cam plate 86 to apply tension to the newly formed stitches as the needles are raised through the stitches preparatory to the next counterclockwise or forward movement of the cylinder.

It is believed to be clear from the foregoing that during rotary or round and round knitting the sinkers are directed along a path in which the stitches are drawn by the needles in front of the neb portions of the sinkers at each of the knitting stations 30 and 31. During reciprocatory or back and forth knitting, however, the sinkers are directed along one path at the leading station of the two stations in each direction of reciprocatory movement so that the stitches will be drawn in front of the neb portions of the sinkers by the needles and that the sinkers are directed along another or modified path at the trailing station in each direction of movement so that the stitches will be drawn in back of the neb portions. Hence in each direction of knitting during reciprocatory operation of the machine the yarn extending between the yarn feeding means and the last needle of the active group of needles to take yarn at the leading knitting station will be prevented from entering the throats of the sinkers at the trailing knitting station.

It will be understood that the improvements specifically shown and described by which the above results are obtained, can be changed and modified in various ways without departing from the invention herein disclosed and hereinafter claimed.

I claim:

1. In a multifeed circular knitting machine having a needle cylinder, latch needles movably mounted therein, sinkers associated with said needles, cam means at each of said feeds for operating said needles along the same stitch drawing path during rotary and reciprocating movements of said cylinder, cam means at each of said feeds for operating said sinkers in timed relation to said needles, said sinker operating cam means acting to move said sinkers along first substantially identical paths at said feeds during rotary movement of said cylinder, and said sinker operating means acting to move said sinkers along their first path at one feed and a second path at another feed in one direction of reciprocatory movement of said cylinder, and along a second path at said one feed and along their said first path at said other feed in an opposite direction of reciprocatory movement of said cylinder.

2. In a multifeed circular knitting machine having a needle cylinder, latch needles movably mounted in said cylinder, sinkers associated with said needles, cam means at each of said feeds for operating said needles along the same paths during rotary and reciprocatory movements of said cylinder, cam means at each of said feeds for operating said sinkers along the same path at each of said feeds during rotary movement of said cylinder, said sinker operating cam means at one of said feeds including means for moving said sinkers along a path different from the path of movement of said sinkers at the other of said feeds during reciprocatory movements of said cylinder in one direction, and said sinker operating cam means at the other of said feeds including means for moving said sinkers along a path different from the path of movement of said sinkers at said one feed during reciprocatory movements of said cylinder in an opposite direction.

3. In a multifeed circular knitting machine having a needle cylinder adapted for both rotary and reciprocating movements, latch needles movably mounted in said cylinder, sinkers having nebs cooperating with said needles, cam means at each of said feeds for operating said needles along the same stitch drawing path during rotary and reciprocatory movements of said cylinder, cam means at each of said feeds for operating said sinkers along the same paths during rotary movement of said cylinder whereby said needles draw stitches in front of the nebs of said sinkers, said sinker cam means at one of said feeds including means for moving said sinkers along a different path whereby the stitches are drawn by the needles in

back of the nebs of said sinkers at said one feed during reciprocatory movements of the cylinder in one direction, and said sinker cam means at the other of said feeds including means for moving said sinkers along a different path whereby stitches are drawn by the needles in back of the nebs of said sinkers at said other feed during reciprocatory movements of said cylinder in the opposite direction.

4. In a two-feed circular knitting machine having a needle cylinder, latch needles movably mounted in said cylinder, sinkers associated with said needles, cam means at each of said feeds for operating said needles along the same stitch drawing path during rotary and reciprocatory movements of said cylinder, fixed cam means at one of said feeds for operating said sinkers along one path in timed relation to said needles during rotary movement of said cylinder, said fixed cam means including means for operating said sinkers along a different path during reciprocatory movements of said cylinder in a direction opposite to said rotary movement, cam means including movable cam members for operating said sinkers at the other of said feeds, means for moving said movable cam members whereby said sinkers are moved along one path during rotary movement of said cylinder, and means for moving said movable cam members to another position whereby said sinkers are moved along a different path during reciprocatory movements of said cylinder in a direction opposite to the direction of said rotary movement.

5. In a multifeed circular knitting machine having a needle cylinder, latch needles movably mounted in said cylinder, sinkers associated with said needles, cam means at each of the feeds for operating said needles along the same stitch forming paths during both rotary and reciprocatory movements of said cylinder, means at each of said feeds for operating said sinkers in timed relation to said needles, said operating means for said sinkers at one of said feeds comprising cams for moving said sinkers along one path during rotary movement of said cylinder and for moving said sinkers along a different path during reciprocatory movements of said cylinder in a direction opposite to said rotary movement, said operating means for said sinkers at the other of said feeds comprising movable cams, pattern means for positioning said movable cams to move said sinkers along one path during rotary movement of said cylinder, and resilient means for positioning said movable cams to move said sinkers along a different path during reciprocatory movement of said cylinder in a direction opposite to said first mentioned direction.

6. In a multifeed circular knitting machine having a needle cylinder, latch needles movably mounted in said cylinder, sinkers associated with said needles, cam means at each of the feeds for operating said needles along the same stitch forming path during both rotary and reciprocatory movements of said cylinder, means at each of said feeds for operating said sinkers in timed relation to said needles, said operating means for said sinkers at one of said feeds comprising cams for moving said sinkers

along one path during both rotary and reciprocatory movements of said cylinder in one direction, and cam means for moving said sinkers along a different path during reciprocatory movements of said cylinder in a direction opposite to said one direction, and said operating means for said sinkers at the other of said feeds comprising movable cams, pattern means for positioning said movable cams to move said sinkers along one path during rotary movement of said cylinder, means for positioning said movable cams to move said sinkers along a different path during reciprocatory movements of said cylinder in said first mentioned direction, and additional cams for moving said sinkers along a path different than the path of movement of said sinkers at said one feed during said reciprocatory movements of said cylinder in said opposite direction.

7. A method of knitting on a multifeed circular knitting machine having needles and sinkers which are operated in cooperative relation in forming yarns into stitches of a tubular fabric during both rotary and reciprocatory operation of the machine, comprising the steps of operating said sinkers along the same path at each of the feeds during rotary operation of the machine whereby stitches are formed by said needles in front of the neb portions of said sinkers, and operating said sinkers along different paths at said feeds during reciprocatory operation of said machine whereby stitches are formed by said needles in front of the nebs of said sinkers at one of said feeds and in back of the nebs of said sinkers at the other of said feeds.

8. A method of knitting on a multifeed circular knitting machine having needles and sinkers which are operated in cooperative relation at each of the feeds in forming yarns into stitches of a tubular fabric during both rotary and reciprocatory operation of the machine, the steps of operating said sinkers along the same path of each of the feeds during rotary operation of the machine whereby stitches are formed by said needles in front of neb portions of said sinkers, operating said sinkers along different paths at said feeds during reciprocatory operation of said machine in one direction whereby stitches are formed by said needles in front of the neb portions of said sinkers at one of the said feeds and in back of the neb portions at the other of said feeds, and operating said sinkers along different paths at said feeds during reciprocatory operation of said machine in the direction opposite to said first mentioned direction whereby stitches are formed by said needles in front of the neb portions of said sinkers at said other feed and in back of the neb portions of said sinkers at said one feed.

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