Jan. 5, 1954 J. J. McDONOUGH 2,664,723

CIRCULAR MULTIFEED HOSIERY KNITTING MACHINE

Filed Sept. 8, 1951 4 Sheets-Sheet 1

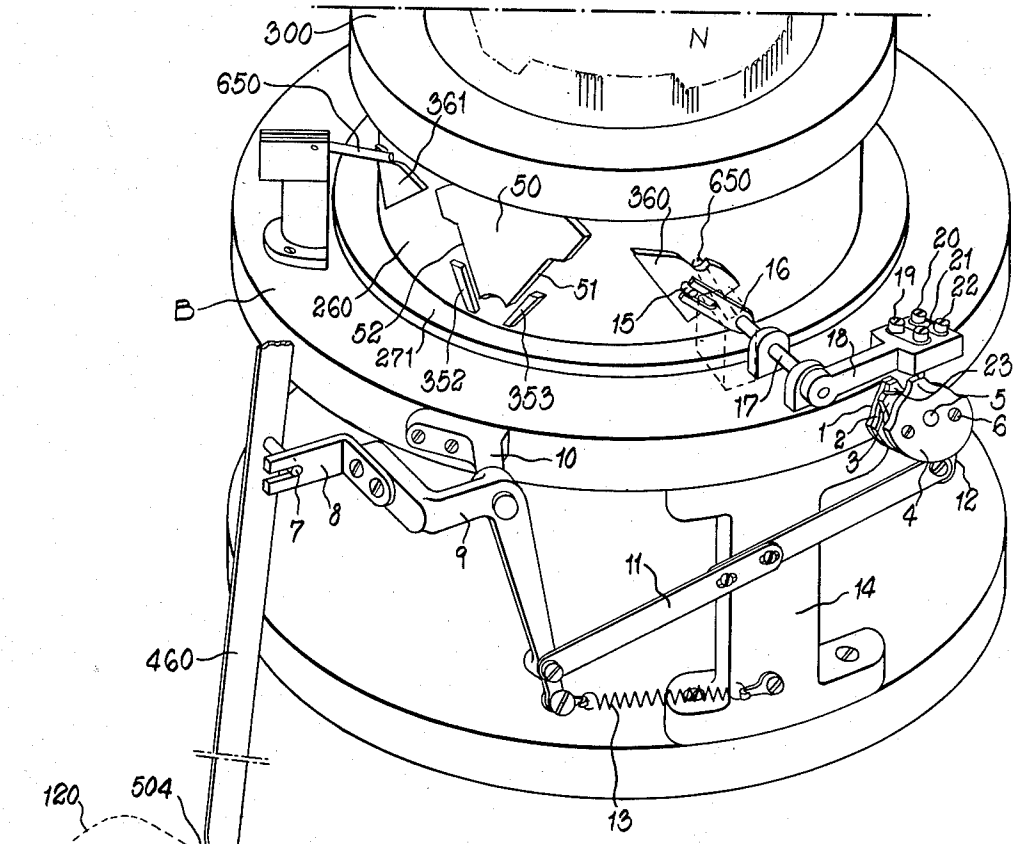


Fig. 1.

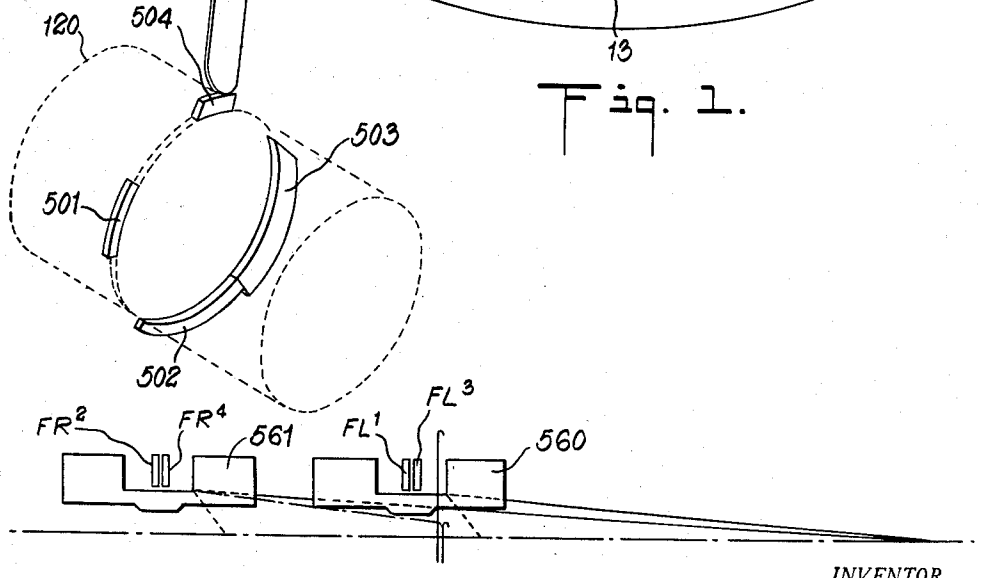


Fig. 2.

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Filed Sept. 8, 1951 4 Sheets-Sheet 2

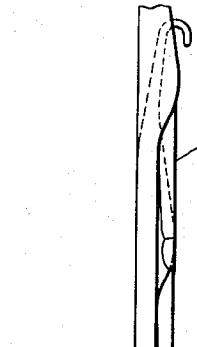
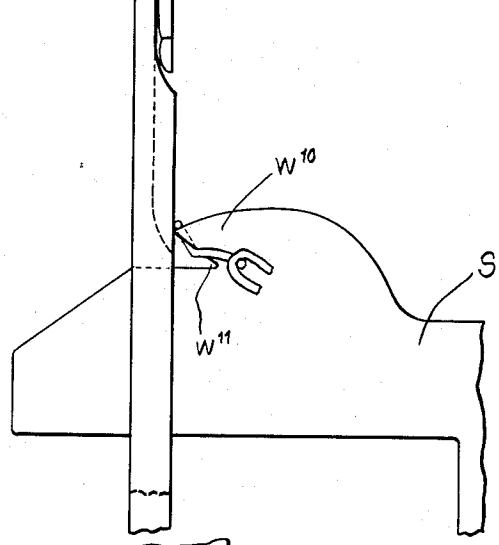


Fig. 2.



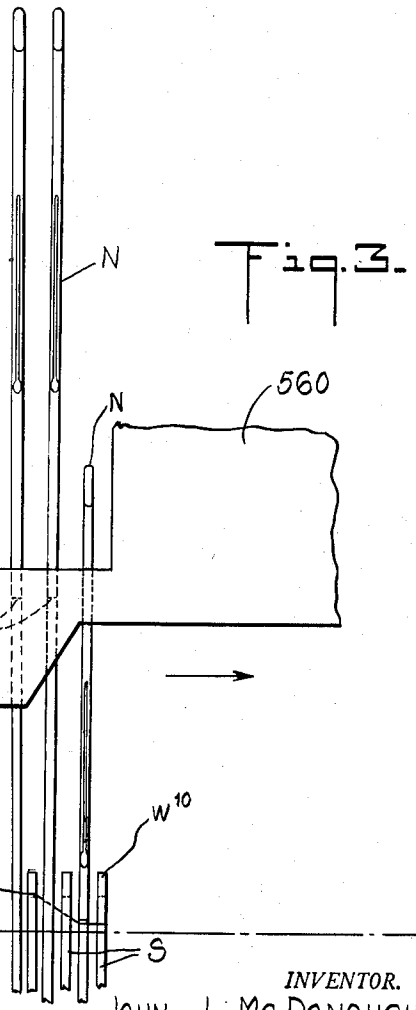


Fig. 3.

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CIRCULAR MULTIFEED HOSIERY KNITTING MACHINE

Filed Sept. 8, 1951 4 Sheets-Sheet 3

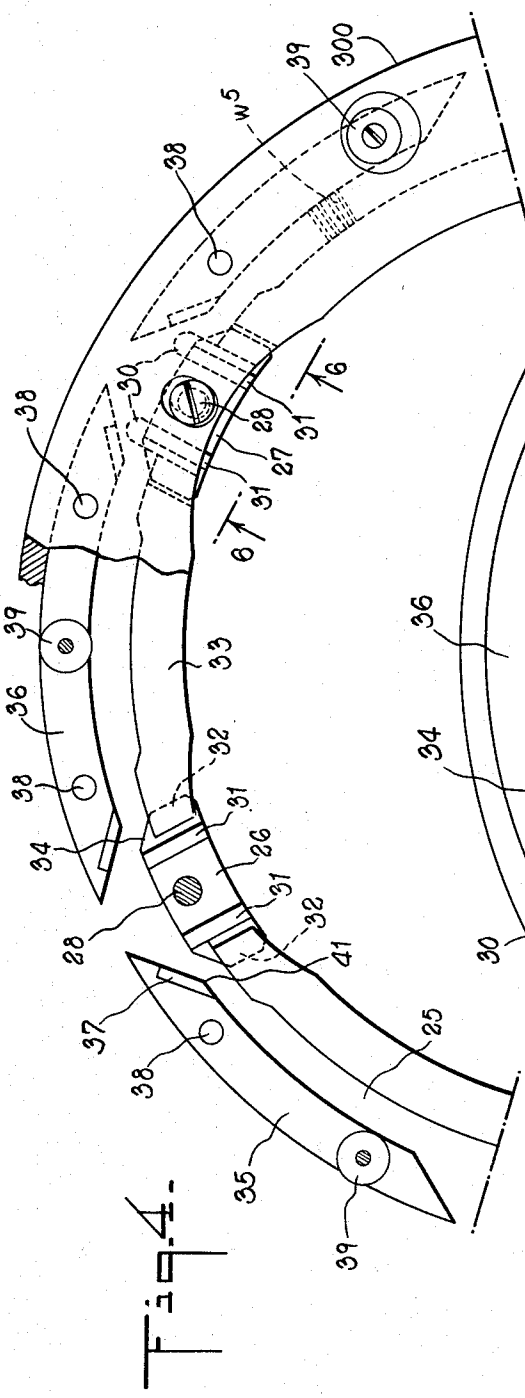


Fig. 4.

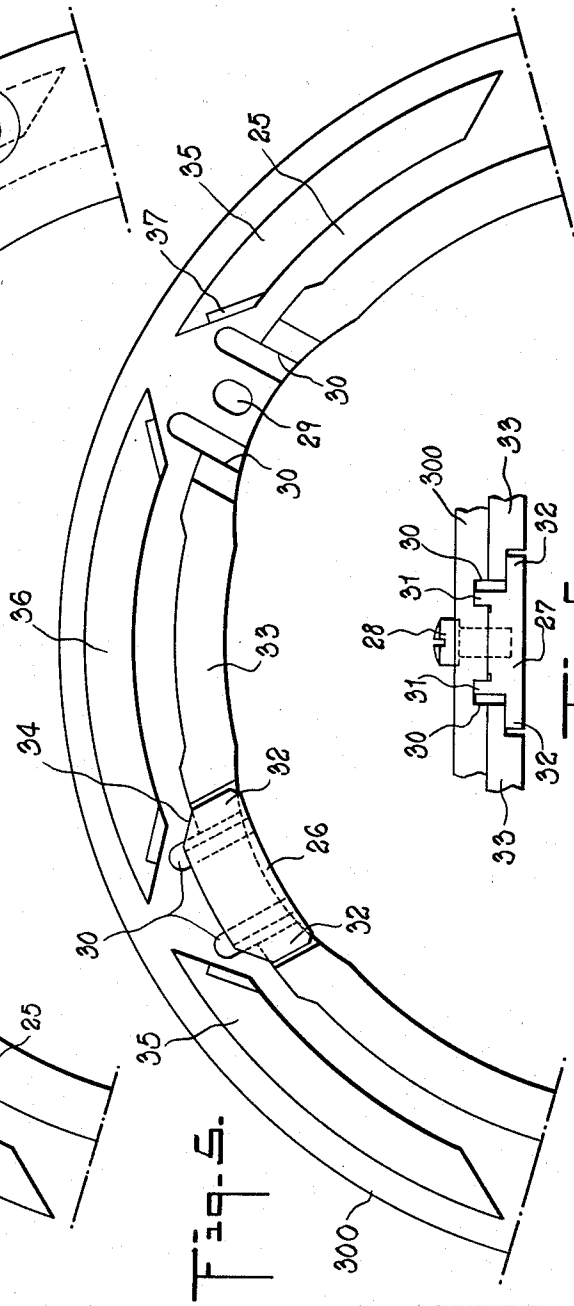


Fig. 5.

Fig. 6.

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CIRCULAR MULTIFEED HOSIERY KNITTING MACHINE

Filed Sept. 8, 1951 4 Sheets-Sheet 4

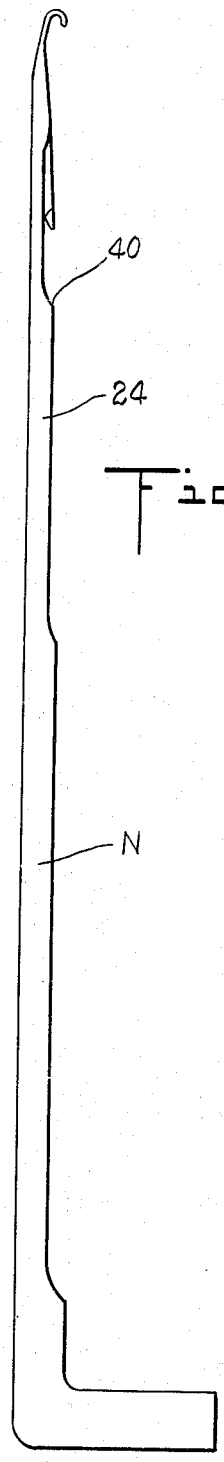


Fig. 7.

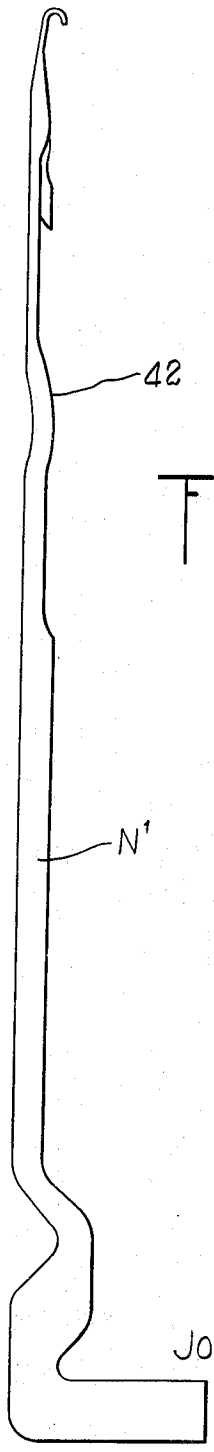


Fig. 8.

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2,664,723

UNITED STATES PATENT OFFICE

2,664,723

CIRCULAR MULTIFEED HOSIERY KNITTING MACHINE

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Application September 8, 1951, Serial No. 245,719

13 Claims. (Cl. 66—54)

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This invention relates to circular multi-feed hosiery knitting machines having independent needles and adapted to narrow and widen the fabric while knitting multi-feed reciprocatorily. The invention relates more particularly to coordination of the needle and cooperating elements at the feed or feeds following the leading feed, to produce improved fabric while narrowing or widening multi-feed in a reciprocatory manner.

It has been found that when making heels and toes of circular knit stockings by knitting multi-feed in a reciprocatory manner, difficulties arise in incorporating the yarn in the fabric. For example, if a two-feed machine is properly adjusted and making uniform fabric in the leg of the stocking, experience shows that the machine may not continue to make uniform-size stitches during heel and toe reciprocatory two-feed knitting. Sometimes a washboard effect occurs in the heel or toe under these conditions in spite of the fact that the machine may have knit a perfect leg or foot fabric. In addition, the cooperation of needles and associated elements may cause trouble at the second feed to knit when reciprocating in the making of heel and toe or like fabric. I refer here to the fact that the yarn from the first feed may get caught under the sinker nebs at the second feed and be fractured. These troubles in multi-feed, reciprocatory knitting are cured by my invention.

It is characteristic of my invention that the yarns are so manipulated by the needles and sinkers near the second feed during reciprocatory knitting that the difficulties are avoided. Thus, I have found that a more even heel and toe fabric is obtained if the stitch cam at the second feed in the run-down or rotary direction is given an independent different adjustment during reciprocatory knitting. I have also found that the breaking of the yarn from the first feed during reciprocatory knitting due to being caught in the sinkers at the next knitting point can be avoided by special adjustment of the center sinker cam and the use of a special needle.

In the drawings—

Fig. 1 is a perspective view from the right rear of pertinent parts of a two-feed, circular, independent needle hosiery knitting machine made in accordance with my invention, showing some of the parts at the trailing yarn feed.

Fig. 2 is a partial diagrammatic view of the principle of the action of the last active needle and the first idle needle as they are passing the second throat plate on a run-down stroke in reciprocatory knitting, in side elevation from the left side as they appear in Fig. 3.

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Fig. 3 is a developed view at the second feed of my machine from the outside showing how the yarns from the first feed are saved from being caught under the nebs of sinkers adjacent idle needles when passing the second feed on a rundown stroke in reciprocatory knitting.

Fig. 4 is a plan view of part of the sinker cam ring of a machine in accordance with Fig. 1, the upper face of the plate being shown broken away at the left of the figure.

Fig. 5 is a view similar to Fig. 4, taken from the bottom of the sinker cam cap, with the sinker center cam itself omitted at the feed point at the right of the figure.

Fig. 6 is a detailed view in elevation looking radially outward on the line 6—6 of Fig. 4, showing the adjustable mounting of the sinker cam.

Fig. 7 is a view in side elevation of a needle with a widened shank such as used in the preceding figures.

Fig. 8 is a view similar to Fig. 7 of an alternate form of needle with a widened shank also suitable for use in a machine made in accordance with my invention.

Fig. 9 is a developed view in elevation of the two throat plates and yarns seen from the outside of the machine while the machine is knitting in the run-down direction.

The example of the invention shown in the drawings is a two-feed embodiment of the well-known Model K Scott & Williams revolving needle cylinder machine adapted to make ladies' stockings with automatic inturned welt. (See U. S. patent to Robert W. Scott No. 1,282,958, dated October 29, 1918, for the basic single-feed Model K construction or the Robert W. Scott U. S. Patent 1,148,055, dated July 27, 1915.) The machine is adapted to make a selvedge start-up from the bare needles multi-feed, to make an automatic inturned welt multi-feed and also to knit multi-feed in both rotary and reciprocatory movements in the making of a stocking. The general construction of the machine shown and described herein is the same as in my U. S. patent application entitled "Circular Multi-Feed Hosiery Knitting Machine and Method of Operating Same," filed April 26, 1948, Ser. No. 23,284, now Patent No. 2,576,962, dated December 4, 1951. The machine contains independent latch needles moving vertically in the needle cylinder 260 of the above cited patents and of this application.

The basic parts of the machine are unchanged from the above-mentioned Scott & Williams Model K machine, the needle cylinder 260 rotating and reciprocating inside the cam ring 271. There are independent latch needles N moved ver-

tically by stitch cams, etc., acting on the butts of the needles (see Fig. 1). While I have shown latch needles, my invention is also applicable to bearded independent needles. The cam ring and needle cylinder are supported in the upper bedplate B and are driven from standard driving parts. As heretofore, the machine is under the general control of a pattern chain which in turn controls a pawl that operates a main pattern drum 120 (see Fig. 1). On the surface of the main pattern drum are drum cams, such for example as those marked 501, 502, 503, 504, whose indications are transmitted by means of the usual thrust bars 460 to the region of the upper bedplate. Thence the indications are distributed around the needle cylinder and cam ring to cause the necessary changes in manipulations of the knitting elements of the machine. The usual circle of webholding sinkers S is carried on the upper end of the needle cylinder, the sinkers being radially movable independently of each other. These radial movements are given to the sinker butts w^5 by a cam path 25 on the inside of the sinker cam cap 300 (see Figs. 4 and 5). Each sinker has the usual web w^{10} for holding the fabric down when a needle is rising through the stitch. The yarns are shown fed to the needles by pairs of pivoted yarn fingers FL^1, FL^3, FR^2, FR^4, located in two throat plates 560, 561.

It should be understood that while I will show and describe my invention embodied in a machine having only two feeds, the invention is equally applicable to a machine having a greater number of feeds or knitting points. In multi-feed hosiery machines of the type disclosed in this application there is one less throat plate than there are stitch cams but there are twice as many stitch-drawing surfaces as there are throat plates. Thus in the example shown in the drawings there is a so-called right-hand stitch cam 361 which acts as a clearing cam when the knitting is proceeding in a rotary direction and provides a stitch-drawing surface for the second feed when the machine is running in the reverse direction. When the machine is turning in the rotary or run-down direction the needles are moving from left to right as they appear in Fig. 3. There is a corresponding left-hand stitch cam 360 which provides a stitch-drawing surface for the second feed of the machine when the machine is turning in the rotary or run-down direction. It also serves to clear the needles before the first feed when the machine is running in a reverse direction. In between these two cams I provide an intermediate or double center stitch cam 50, i. e., one stitch-drawing surface for each direction of movement. The two surfaces on this cam slope downwardly toward each other, the two slopes 51, 52 each constituting a stitch-drawing surface. In the example shown these faces happen to be in fixed radial relation to each other, though this is in no way essential to the present invention. I also provide two raise cams 352, 353 at the bottom of this double center cam 50—one on each side of it. One function of these raise cams is to assist in clearing needles which have been drawn down by either the stitch-drawing surface 51 or the stitch-drawing surface 52.

It will be seen that when the machine is running in the rotary or run-down direction the stitch-drawing surface for the first feed, i. e., the one fed by yarns coming from the throat plate 561, is the left-hand surface 52 on the double center cam, as shown in the drawings. When turning in this direction the stitches for the second feed are made of yarns from yarn fingers FL^1 and FL^3 in the left-hand throat plate 560 and the stitches are drawn at the left-hand stitch cam 360. The left-hand stitch cam is drawing stitches only when the machine is turning in the run-down direction. When the machine is turning in the reverse direction during reciprocation, the yarns from the left-hand throat plate 560 are drawn into stitches on the right surface 51 of the double center cam to form the first course and the second course is made when yarns coming from yarn fingers FR^2 and FR^4 in the right-hand throat plate 561 are taken by needles N descending the stitch-drawing surface of the right-hand stitch cam 361.

The left-hand stitch cam 360 is so mounted on the cam ring 271 that it can be raised or lowered to change the length of stitch which it draws. This is the stitch-drawing surface at the second knitting point in the rotary or run-down direction.

I have found that the adjustment of this left-hand stitch cam 360 is extremely important. It is very difficult in knitting heels and toes by multi-feed knitting on circular machinery to avoid what are known as washboard effects. I have discovered that in a multi-feed machine knitting reciprocatorily to make a heel and toe by narrowing and widening, if this trailing or second stitch cam in the run-down direction is given a slightly different adjustment, the washboard effects are reduced or avoided.

In this example the special adjustment at the second feed stitch cam in the run-down direction during reciprocatory knitting involves a slight shortening of the stitch and is so shown. However, it is sometimes possible also to avoid the washboard effects by slightly lengthening the stitches at this cam during multi-feed reciprocation.

I also use this stitch cam adjustment to give other adjustments beside the one to avoid washboard effects in the heel and toe. Thus after the makeup this stitch cam is usually lowered while making the welt so that every other course in the welt will be loose. This makes it possible to produce a looser welt with less noticeable distortions. In addition, the adjustability of this stitch cam can be used to make a looper's loose course following completion of the toe.

The control means for this adjustment will be described next.

These control means are of such a nature that the sizes of the stitches can be adjusted independently for rotary and reciprocatory knitting. The significant element of the control mechanism is a series of plates or disks 1, 2, 3, 4 fastened together and rocked about a coaxial pivot point 5 under control of the four cams 501, 502, 503, 504 on the main pattern drum 120. These assembled disks form a means consisting of a series of cut-away cam paths, each path having a single high point. The remainder of the periphery of each disk is lower than the high point of the other disks. The high points of the various disks are so located that when the disks are assembled together coaxially as by means of screws 6 passing through the entire group, the high points on the adjacent disks can come at different points or positions on the circumference of the assembly. This cut-away means is rocked about its coaxial center through connections from the main pattern drum 120. For this purpose I provide a thrust bar 460 extending upwardly from the pattern drum. The thrust bar is actuated by the

cams 501, 502, 503, 504, all of which are located on a single path on the drum. This bar has a pin 7 extending laterally from it near the level of the upper bedplate B. This pin is engaged by the forked end of an extension 8 of a bell crank lever 9 pivotally mounted on a bracket 10 on the edge of the bedplate. The other arm of this bell crank lever is attached to the cut-away cam means by an adjustable bar 11 linked to a depending ear 12 on one of the disks. There is a tension spring 13 connecting the end of the bell crank lever and a fixed post 14 supporting the upper bedplate B on the machine. This tension spring tends to keep the thrust bar 460 down in contact with the surface of the pattern drum. The thrust bar is able to reach this position when the cut-away means is rocked toward the left as it appears in Fig. 1.

The heights of the drum cams 501, 502, etc. are such with relation to the dimensions of the parts just described that as the thrust rod rises onto a drum cam the cut-away means is rocked far enough to bring a new high point on the cam disk series into operative relation with the stitch cam by the elements now to be described.

On the left-hand stitch cam 360 is a pin 15 extending laterally radially outward. This pin is engaged by a forked arm 16 pivoted in a horizontal shaft 17 mounted on top of the upper bedplate. This shaft extends from the stitch cam to the outer edge of the bedplate where it carries a lever arm 18 overlying the cutaway cam disks 1, 2, 3, 4. Four screws 19, 20, 21, 22 pass through the arm and down into the paths of the high points 23 on the disks 1, 2, 3, 4. The screws are mounted in such positions and at such angles that each screw lies in the path of a different cam disk and, if desired, at a different circumferential point over the cam means. By adjusting one of these screws the length of stitch drawn by the left-hand stitch cam 360 is adjustable independently of the stitch length adjustment corresponding to the high point on any other disk. The adjustable screws in the arm leading to the left-hand stitch cam 360 and the high points are so located that each screw contacts its high point when the other high points are out of contact with their screws. It therefore follows not only that the different heights of cams on the drum will cause different lengths of movement of the stitch cam 360 but the amount of movement of the stitch cam will be determined by the screw associated with the disk, rather than with the height of the drum cam. In the drawings the drum cams shown are as follows. For the toe and heel there are no cams, the thrust bar resting on the surface of the drum. A low cam 501 is used for the foot and another low cam 502 of the same height for the leg. An intermediate high cam 503 is used for the welt and garter top of the stocking and a high cam 504 is used to provide slack stitches to make it easy for the toe of the stocking to be put on the looping machine. The drum and cam heights could be arranged otherwise to give any desired order of drum selection.

The most important aspect of the mechanism just described is the independent adjustability of the position of the stitch cam for the reciprocatorily knit parts of the stocking to reduce or remove the washboard effect. As is customary in circular independent needle hosiery knitting machines of the present day, the main pattern drum also controls the shift of the machine from rotary to reciprocatory knitting, and vice versa.

It will be obvious that the means which I have described make it possible to give the trailing yarn fed in only the run-down direction a special stitch length adjustment during reciprocatory knitting and to return that cam to its regular adjustment when the machine returns to rotary knitting. I have found that this is the way in which the washboard effect in the heels and toes of circular knit hosiery can be reduced or avoided.

In single-feed machines it has heretofore been known when retracting sinkers at a knitting point for yarn feeding purposes to return the sinkers to their radially inward position at a slow rate in order to ensure that the yarns will have plenty of time to get above the sinkers at the first idle needle. Because the yarns are fed from a single throat plate on a single-feed machine and the yarns come off the corner of the throat plate where the sinkers are starting to come in again, the sinkers are normally allowed to come out at the middle of the center knitting cam so far that their nebs are considerably beyond the shanks of the needles. However, I have discovered that unless some special provision is made to prevent it, the yarns that were knit at the first knitting point on a multi-feeed machine will fall below the nebs of the sinkers at the second knitting point if the nebs are pulled out beyond the shanks of the needles.

During reciprocatory knitting in the heels and toes of circular knit hosiery only certain needles are active and the group is either being reduced during narrowing or added to during widening. Owing to the necessary length of the oscillation or throw of the needle cylinder to carry all the active needles beyond the stitch cams, the length of the yarn lying from the last needle to knit to the throat plate of the first feed of the machine is quite long and on multi-feed machines the yarn is held at a low angle. Because of this low angle there is danger of this yarn from the first feed being caught under the nebs of the sinkers at the second feed. At this point, i. e., the second feed, the sinkers are retracted to allow the yarn at the second feed to be fed to the needles. If a yarn from the first feed gets trapped under the neb of a sinker at the second feed at the end of either stroke of the machine, it is liable to be cut or fractured. I have devised a simple coordination of the standard parts of this circular knitting machine which avoids all this difficulty without introducing the necessity for any additional parts.

To avoid this risk of yarns being fractured, I have shaped and coordinated the standard needle and cooperating elements as follows: In the first place, I use in the machine a known type of independent latch needle which has different widths when viewed in side elevation. In the needle shown in Fig. 7, beginning a short distance below the latch when opened, the shank is widened out at 24 on the hook side to a thickness in the plane of the hook approximately equal to the narrower portion opposite the latch plus the space occupied by the latch when fully open. The hook side is the edge of the needle facing the sinker nebs. In the needle shown in this figure the shank of the needle opposite the latch, plus the space occupied by the latch when fully open may, for example, be equal to .035". A short distance below the end of the latch when thus opened, the shank would then have a shoulder 40 which widens it out from .027" to a total thickness of .041". It will be noted that at this point the width of the needle about equals the width of the needle above it plus the latch. The needle

continues this width downwardly for a considerable distance until the shank is thickened again to .055", which width it maintains until just above the butt. The first described widening—beyond the latch—is taken advantage of according to my invention. When active needles are receiving yarn they are so low that the incoming yarn approaches the needle above the shoulder **40** at the top of this thickened portion. I have discovered that while yarns at the second feed can get into the hooks of the needles and be caught in the throats of the sinkers under the nebs because they are opposite the narrowest portion of the shank of the active needle, it is possible to prevent the idle yarn from the first feed getting caught below the nebs of the idle needles. I have noticed that when an idle needle passes a throat plate and knitting point, the thickened portion **24** is opposite the nebs of the adjacent sinkers. I limit the retraction of the sinkers to a point where the nebs do not clear the circle formed by the thickened portions of the shanks of the idle needles. The nebs of the sinkers are pulled out nearly even with the circle formed by the thickened portion of the needle. They do not clear and they can have a slight overlap. At no time should they be beyond this circle formed by the thickened portion of the shanks of the idle needles. I have then found that after feeding to the last active needle the yarns from the first feed can be laid on top of the nebs of the sinkers and subsequently will not fall down into the throats of the sinkers at the second knitting point if the points of the sinker nebs w^{10} are not withdrawn beyond the circle formed by the thickened part **24** of the needle at the second knitting point. In this way the yarn that was knitting at the first knitting point cannot get below the nebs of the sinkers at the second knitting point and the liability to fracture is eliminated. However, at the active needles the second-feed yarn gets under the nebs as usual.

The position of the first feed yarn from yarn finger FR^3 or FR^4 in the first throat plate **561** as the last active needle and the first idle needle pass the second throat plate **560** is seen in Figs. 2 and 3. The needles in Fig. 3 are moving from left to right and all parts other than yarn from the first throat plate **561**, second throat plate, needles and sinkers, are omitted. The movement of the needles in this figure is in the forward or rotary direction.

The sinker cam cap **300** which gives the sinkers their radial movements is shown in detail in Figs. 4, 5 and 6. I have shown the part of the cap which corresponds to the two knitting points. The sinker butts w^5 move in an enclosed path **25** (Fig. 4). The center cams for retracting the sinkers radially at the two feeds to permit introduction of the new yarn in the throat w^{11} and below the sinker nebs w^{10} of the sinkers are indicated generally by the reference characters **26** and **27**. These cams are radially adjustable and once fixed in proper position are not disturbed during knitting. In distinction to prior practice this cam is so set that when a needle is in its idle position the neb of the sinker does not clear the circle formed by the widened portion **24** of the needle. At no time does the new sinker center cam pull the sinkers out so that the nebs are beyond the circle formed by the widened part of the needles. If this were not true the yarn that knits at the first feed and that has been taken out of action at the first idle needle would fall below the nebs of the sinkers as they are withdrawn at the second knitting point. If this yarn were to fall below the nebs of the sinkers and get into the throats w^{11} of the sinkers at the second knitting point, it is liable to be fractured. By pulling the sinkers out till their noses or nebs are nearly even with the circle formed by the widened portion **24** of the needles, this difficulty is avoided. However, the yarn at the second knitting point is able to feed below the nebs of the sinkers associated with the active needles.

As can be seen in Fig. 6, the new sinker center cam is locked underneath the sinker cam cap **300** by a screw **28** passing through a slot **29** from the top of the cap. The slot enables the cam to be given its radial adjustment. To keep the cam facing in true radial position, two long open-ended radial slots **30** are cut in the cap **300**—one on each side of the screw slot **29**. On the upper face of the cam are two upstanding radial ribs **3** which fit in close sliding contact against one edge of each long slot **30**. The sliding contact is with the inner long slot edges, i. e., the edges toward the center of the cam. There is no contact between the outer edges of the long slots and the outer radial edges of the ribs **31** on the cam (see Fig. 6). The lower part of the cam has ears **32** extending circumferentially of the cap under notched ends of the adjacent inner sinker guide cams **33**. As can be seen from the drawings, there is vertical contact between the ears **32** and the guide cams **33**. However, no vertical circumferential outer edge of any part of the cam is in contact with the guide cams and therefore the circumferential position of the center cam is determined wholly by the single face sliding contact of the cam on each long slot **30**. The center cam is bevelled at **34** at each end on its radially outward face to retract the sinkers and presents a circumferentially even face between these bevels.

I provide side cams **35**, **36** for pushing the sinkers back in for casting off the stitches. Since, of course, these cams must operate during reciprocatory knitting as well as during rotary knitting, I provide an insertion of especially hard material on the bevelled edge **37** on each side of each center cam. These are part of the two-piece double-ended side cam **36** between the two center cams. These side cams are adjustably mounted at points **38** intermediate their ends in order that their bevelled edges may be adjusted to give the exact inward movement desired for the sinkers after the latter have been retracted. I locate eccentric buttons **39** at the other end of the cam from the adjustable screws **38** in order to give complete adjustability to these side cams, so far as relief is concerned. The double-ended side cam **36** is in two pieces, one eccentric button **39** serving to adjust the ends furtherest removed from the bevelled edge **37** for relief of the sinkers and there being a separate adjusting screw **38** individual to each piece on either side of the middle button to adjust the bevelled edge **37** the right depth for moving the sinkers inward. It will be recognized that this sinker cam cap oscillates during reciprocatory knitting, as occurred in prior machines, such as in my above-mentioned Patent No. 2,576,962. In order to orient the reader I therefore state that the cast-off point **41** of the sinker cam **35** will be positioned during rotary knitting a space equal to a few needles to the right of the lowest point of stitch cam **360** as viewed in Fig. 1. This will be a few needles beyond the lowest point of the stitch cam.

I provide the usual means for raising needles progressively to idle level during reciprocatory

knitting. These may be similar to those shown in my said Patent No. 2,576,962 and in the Scott Patent 1,282,958, above referred to. In Fig. 1 of the present application I have shown two lifter or narrowing picks 650, the one at the right being dotted merely to avoid obscuring the controls for the left stitch cam 360.

The coordination of sinker and needle movements above described also avoids difficulty in instances of multi-feed reciprocatory knitting where two or more needles are lifted out of action simultaneously at the same feed. This two-needle narrowing in multi-feed reciprocatory knitting produces what are termed tie-across yarns. For a more detailed disclosure of tie-across yarns, reference is made to my said Patent No. 2,576,962. According to the present invention the tie-across yarns are prevented simply and easily from getting into the throats of the sinkers. The yarns are fed into the throats of the sinkers adjacent the active needles on an oscillation. When the machine reverses, two or more needles which were at the trailing end of the active group are raised to idle position before they pass through the knitting cams. The yarns are already above the sinkers at the end idle needle. As the two or more leading active needles are added to the idle needles, the yarns turn over on the tops of the nebs of the sinkers at the added idle needles. The yarns are not allowed to drop down into the throats of the sinkers when the first active needle takes yarn, due to the fact that the nebs of the sinkers at the added idle needles are in line with the widened shanks of the idle needles. Therefore the yarns are not allowed to slip below the nebs of those sinkers as the first stitch is drawn.

In Fig. 8 I have shown an alternate form of latch needle N^1 which can be used in my machine to give the new coordination. This alternate form produces the necessary wide portion in the shank of the needle in the plane of the hook opposite the neb when the needle is elevated to idle position by means of a bent shank 42 rather than a generally thickened portion. The bend comes at the proper place to give the nebs a chance to cover the needle. It will be noted that whether I use the thickened needle N or the bent shank needle N^1, I am using a needle heretofore known and that no special needle is required.

It will be seen that my invention for controlling the yarn at the knitting point of the second or following feeds in multi-feed knitting during reciprocatory knitting centers around the needles and their movements and the associated cooperating elements in such a manner that all the objects are achieved without the introduction of any additional parts. It will also be seen that the operation of the machine during rotary knitting and at the leading feed during reciprocatory knitting is not changed in any way, so that by the coordination of parts which I have invented, additional improved results are obtained not only without the addition of any other elements but also without interference with any functions or abilities already present in the machine.

What I claim is:

1. A circular hosiery knitting machine adapted to knit multi-feed on both rotary and reciprocatory knitting, having the following combination of needles and needle-cooperating elements: a circle of sinkers with nebs thereon, cams to withdraw the sinkers at each feed, a circle of independent needles with wide portions on the side of the shanks facing the sinker nebs and intercalated with the sinkers, means adapted to cause the needles to draw stitches at at least two feeds during reciprocatory knitting while keeping the wide portions of the needles below the sinker nebs, and other means to raise needles to idle position progressively, the dimensions and movements of the sinker cams, sinkers, needle cams and needles being so related that needles so elevated present their wide portions opposite the sinker nebs and the latter do not clear the circle formed by those portions of the idle needles but do clear the circle formed by the shank side of the hooks of the active needles, and adjusting means adapted to cause the stitch means to draw stitches of special length in the rotary direction at the last feed during reciprocatory knitting, whereby improved multi-feed, reciprocatorily knit fabric is produced.

2. A circular hosiery knitting machine adapted to knit multi-feed on both rotary and reciprocatory knitting, having a circle of independent latch needles, wide portions on the hook side of the shanks of said needles extending up to a point a short distance below, and further out than, the latch, sinkers with nebs thereon intercalated with the needles, cams to cause said needles to draw stitches at each feed during reciprocatory knitting and means to raise selected needles to an idle level where the wide portions of the needle shanks are opposite the nebs of the sinkers prior to the last feed in the rotary direction, in combination with cam means at the last feed in the rotary direction to withdraw the sinkers radially beyond the line of the back of the hooks but not clear of the circle formed by the wide portions of the shanks of the idle needles, and adjusting means adapted to cause the stitch-drawing cams to make the needles at that feed draw a special length of stitch when knitting in the rotary direction, whereby improved multi-feed, reciprocatorily knit fabric is produced.

3. A circular hosiery knitting machine adapted to knit multi-feed on both rotary and reciprocatory knitting, having the following combination of needles and needle-cooperating elements: a circle of independent latch needles with thickened portions on the shanks, sinkers with nebs thereon intercalated with the needles, cams to withdraw the sinkers at each feed, means adapted to move the needles vertically to draw stitches at at least two feeds in reciprocatory knitting while keeping the thickened portions of the shanks below the sinker nebs, and selecting means to raise needles to idle position progressively, the dimensions and movements of the sinker cams, sinkers, needles cams and needles being so related that needles so selected present their thickened portions opposite the sinker nebs and the latter do not clear the circle formed by those portions at the last feed in the rotary direction, in combination with adjusting means adapted to cause said stitch means to draw stitches of special length in the rotary direction at the last feed during reciprocatory knitting only, whereby improved multi-feed reciprocatorily knit fabric is produced.

4. A circular hosiery knitting machine adapted to knit multi-feed on both rotary and reciprocatory knitting, having stitch-drawing surfaces and yarn feeding means at each feed, in combination with independent sinkers having nebs, independent needles having thickened shank portions which are opposite the nebs of the sinkers when the needles are raised to idle position and narrower portions which are opposite the nebs when

the needles are in an active position, and a cam at a non-leading feed when the machine is knitting in a rotary direction adapted to retract the sinkers for feeding yarn to active needles at that feed but at no time allowing the debs of the sinkers to clear the circle formed by the thickened shanks of idle needles raised out of action, whereby fracture of yarns is prevented during reciprocatory knitting.

5. A circular hosiery knitting machine adapted to knit multi-feed on reciprocatory knitting, having the following combination of needles and needle-cooperating elements: independent sinkers with nebs, cams to withdraw the sinkers at each feed, independent needles having shanks with wide portions normally below the sinker nebs, stitch-drawing surfaces at each feed, means to progressively raise needles to idle level adapted to leave the wide portions opposite the sinker nebs, and a sinker retracting cam at each feed, such cam at the second feed in the rotary direction retracting the nebs clear of the circle formed by the shanks of the active needles but not clear of the circle formed by the wide portions of the idle needles, whereby fracture of the yarn from the preceding feed is avoided during reciprocatory knitting.

6. A circular hosiery knitting machine adapted to knit multi-feed on reciprocatory knitting, having the following combination of needles and needle-cooperating elements: independent sinkers with nebs and cam means adapted to move the sinkers radially, independent needles intercalated with the sinkers, cam means adapted to move the needles vertically to form stitches, narrowing and widening mechanism to move needles progressively to and from an elevated idle level, a plurality of the needles each having a shank whose edge projects different distances toward the sinker nebs at different points on the shank, the sinker cams, sinkers, needle cams and needles being of such dimensions and so coordinated that at the second feed in a run-down direction idle needles present opposite the sinker nebs, portions which project further toward the nebs than the portions presented to the nebs by active needles, and the sinker nebs are retracted clear of the circle formed by the shanks of the active needles but not far enough to clear the circle formed by the edges of the idle needles, whereby fracture of the yarn from the preceding feed is avoided during reciprocatory knitting.

7. A circular independent needle hosiery knitting machine adapted to knit multi-feed on both rotary and reciprocatory knitting, having stitch-drawing surfaces for each feed, in combination with mechanism adapted to vary the height of the stitch-drawing surface at a trailing feed in the rotary direction on reciprocatory knitting, said mechanism being independently adjustable for reciprocatory and rotary knitting, whereby improved reciprocatorily knit fabric is produced.

8. A circular independent needle hosiery knitting machine adapted to knit multi-feed on movements in both the run-down and reverse directions, stitch-drawing surfaces for each of the feeds, a pattern drum, cams of different heights on the drum and means actuated by the drums and cams adapted to vary the height of the run-down stitch-drawing surface at a trailing feed during reciprocatory knitting, said means being independently adjustable for stitch length for different heights of drum cams, whereby said stitch-drawing surface is independently adjustable for reciprocatory and rotary knitting and improved reciprocatorily knit fabric is produced.

9. A circular independent needle hosiery knitting machine adapted to knit multi-feed on both rotary and reciprocatory knitting, stitch-drawing surfaces for each of the feeds, a pattern drum, cams of different heights on the drum, a series of coaxial cut-away cam paths and a lever attached to a stitch-drawing surface at one of said feeds adapted to change the height of said surface, in combination with a series of adjustable screws in the lever each adapted to be engaged by the high point of a different cam path, whereby each height of drum or cam causes a different screw to actuate the lever and the adjustment of the stitch-drawing surface can be changed independently.

10. A circular independent needle hosiery knitting machine according to claim 9 in which the series of cut-away cam paths is a set of disks arranged side by side, each having a single high point with the remainder of the periphery of the disk being below the high points of all the other disks, the drum cams being adapted to rock the disks from one position to another, whereby each disk is effective on its screw for a separate drum selection.

11. A circular independent needle hosiery knitting machine adapted to knit multi-feed on both rotary and reciprocatory knitting, having stitch-drawing surfaces for the feeds, a pattern drum, cams on the drum, certain of said cams controlling the shifting of the machine to and from rotary and reciprocatory knitting, and means actuated by other of said cams adapted to change the height of the stitch-drawing surface at the second feed in the rotary direction, whereby the length of stitch drawn at that feed can be changed when the machine shifts from rotary to reciprocatory knitting or vice versa and washboard effects in the reciprocatorily knit fabric are avoided.

12. A circular hosiery knitting machine having independent needles, a plurality of knitting feeds each having surfaces adapted to draw stitches for knitting in the run-down and in the reverse directions, the stitch-drawing surface in the run-down direction at the next to the leading feed being adjustable as to length of stitch, in combination with mechanism adapted to move this run-down cam to a level, when making reciprocatorily knit fabric, different from that used at the preceding feed, whereby washboard effects in the reciprocatorily knit heel and toe fabric are avoided.

13. A circular hosiery knitting machine having independent needles, two knitting feeds and each having surfaces adapted to draw stitches for knitting in the run-down and in the reverse directions, the stitch-drawing surface at the second feed in the run-down direction being adjustable as to length of stitch, in combination with mechanism adapted to move this run-down cam to a level, when making reciprocatorily knit fabric, different from that used on the other feed or on either feed when making straight rotary work, whereby washboard effects in the heel and toe fabric are avoided.

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