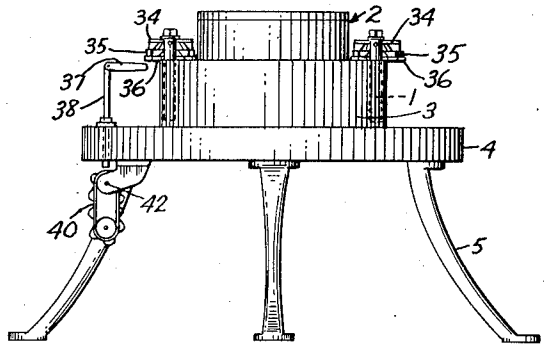
Dec. 14, 1954 C. F. MILLER 2,696,720

CIRCULAR KNITTING MACHINE

Filed July 20, 1949

FIG. 1.



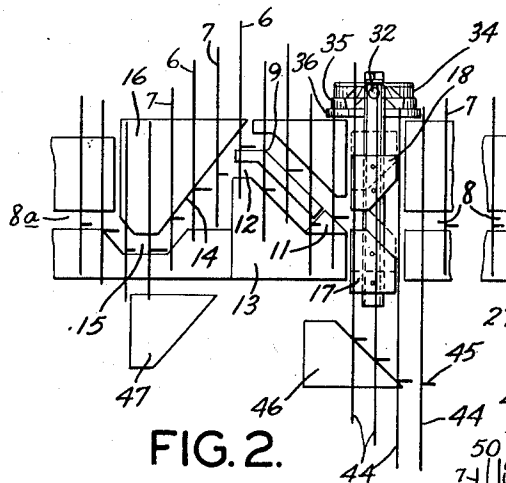


FIG. 2.

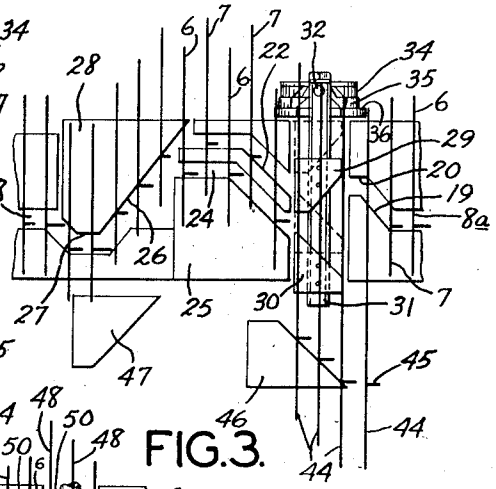


FIG. 3.

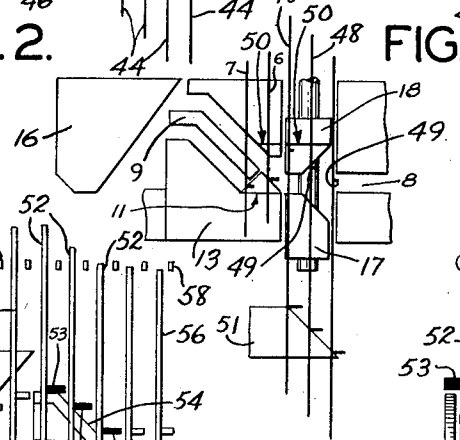


FIG. 6.

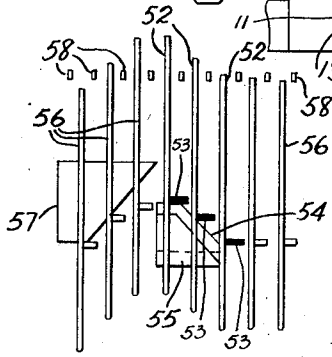


FIG. 4.

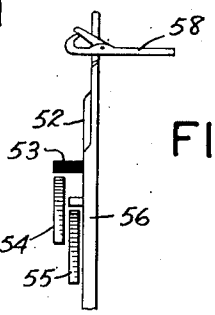


FIG. 5.

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2,696,720

CIRCULAR KNITTING MACHINE

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Application July 20, 1949, Serial No. 105,728

6 Claims. (Cl. 66—20)

This invention relates to knitting machines in which the positions of one or more cams must be changed from time to time in a manner to change its action on the stitch-forming elements subject to it, and in which the change must be made while the knitting operations of the machine continue. This is a characteristic of circular knitting machines as is well known, and for brevity I shall refer hereafter to circular machines substantially only. It is to be understood however that any form of knitting machine in which a cam is to be shifted while in the midst of a field of stitch-forming elements, is to be regarded as an equivalent of a circular machine for the present purposes. The invention is applicable not only to cams for operating needles but also to cams for operating the other devices which on occasion are used to take part in the formation of stitches in knitting machines, e. g. sinkers, pressers, warp-yarn guides, etc., and jacks for operating any of the foregoing, all of which are here classed as stitch-forming elements.

When a cam is shifted in the midst of a field of needles or other stitch-forming elements that are actuatable by the cam, there is danger that one or more of the stitch-forming elements will be brought to or left in a mid-position as it were, where it will be struck later and damaged by the same or another cam. Ordinarily it is necessary to take special precautions to avoid this, and various expedients have been resorted to heretofore. For example, arrangements have been made for operating the knitting machine unusually slowly while the change is being made, so that the change is effected rapidly relative to the speed of the cams along the needle bank. Again, needles have been omitted from the machine at one or more places in a needle bed and arrangements made to shift the cams at such places, i. e. while out of engagement with needles. This permits cams to be shifted without danger of accident, but results in an unknitted stripe or stripes in the fabric, running lengthwise of the fabric. Still again, it has been proposed to use at one or more places in a needle bed, some needles with long butts and other needles with short butts, and divide each cam that is to be shifted into a long butt section and a short butt section. By appropriate placements of the groups of needles and appropriate manipulation of the cam sections, the cam as a whole can be shifted from one position to another without danger.

The present invention provides a cam-shifting arrangement which is somewhat simpler mechanically than the latter expedient, and which does not leave an unknitted stripe in the fabric, and which need not require the machine to be slowed down, at least ordinarily.

Briefly this is accomplished by providing, at one or more places in the bank of stitch-forming elements, one or a group of stitch-forming elements (usually three or four are sufficient) which are so constructed that they are not affected by the cam or cams to be shifted, but so controlled as to knit. To the latter end special mechanism, which may be a cam or cams, may be and preferably is provided to actuate these stitch-forming elements (which I call the special stitch-forming elements) through at least such a part of their operating cycles as may be necessary in view of the fact that they are unaffected by the shiftable cams. The mechanisms which control the shifting of the shiftable cams are then arranged to make the shifts, when needed, while the shiftable cams are passing the special stitch-forming element or group of special stitch-forming elements. Obviously, a shiftable cam can be moved, at such a place, from one

position to another without danger of misplacement of a stitch-forming element, and at the same time no unknitted stripe is left in the fabric. In order that the special stitch-forming elements may not be affected by the shiftable cam or cams, preferably the special stitch-forming elements are wholly devoid of butts at the path of the shiftable cam or cams, and are passed through their knitting motions by butts located outside the paths of the cams which actuate the, say, remaining and major number of the stitch-forming elements of the bank. If however it is desired for any reason that the special stitch-forming elements have butts in the path of some cam operating the remaining needles, usually some cam of that path can be cut in such a manner as to permit the presence of the desired butts.

The accompanying drawings illustrate examples of the foregoing as applied to the actuation of needles, and from which its application to other forms of stitch-forming elements will be understood. In those drawings Fig. 1 is a diagrammatic elevation of a two-feed circular knitting machine. Fig. 2 is a diagrammatic illustration at one of the feeds of the machine of Fig. 1 as viewed from within the bank of needles. Fig. 3 is a similar illustration at the other of the two feeds of the machine of Fig. 1. Fig. 4 is a diagrammatic illustration of the camming system of another embodiment of the invention, and Fig. 5 illustrates sectionally the needle and cam relations of Fig. 4. Fig. 6 is a view similar to Fig. 2 or Fig. 3 but showing an arrangement in which the special stitch-forming elements have butts in the same race as a cam that is to be shifted.

The machine shown in Fig. 1 is a two-feed dial-and-cylinder sliding-needle knitting machine having the usual arrangement of needle cylinder **1** and needle dial at **2**. As will be understood, much of the mechanism of the machine, and even essential mechanism, has been omitted from Fig. 1 for clarity since the omitted mechanism forms no part of the invention. A cam ring **3** carries the cams which cause the cylinder needles to perform their knitting operations, e. g. in the present instance project and retract the cylinder needles, and a cam cap on the dial at **2** carries the cams which actuate the dial needles, as is customary in this form of machine. The needle beds and the cam carriers are mounted, directly or indirectly, on the base **4** of the machine which is carried by the legs **5**. In the present instance the needle beds **1** and **2** are stationary and the cam ring and dial cam cap rotate, synchronously, but it will be understood that the invention is as applicable to machines in which the needle bed or beds rotate and the cam carriers are stationary. Also it is to be understood, and will become obvious as this description proceeds, that the invention is not limited to dial and cylinder machines, but is applicable to other forms of machines also, e. g. machines having only a single needle bed, links-and-links machines, etc.

The cam arrangements for the cylinder needles at the two feeds of this machine of Fig. 1 are shown in Figs. 2 and 3 respectively, and as representative of arrangements that may be made to secure variation in the knitting (i. e. to produce a patterned or fancy effect cloth, or some desired construction of the cloth) some of the cylinder needles **6** are given long operating, i. e. cam-engaging, butts while the remainder of the cylinder needles **7** (excepting the special needles referred to again) are given shorter operating butts. The number of each form of cylinder needle and their distribution is determined, as heretofore, by the effect to be produced. Likewise the manner in which the dial needles are actuated is not material to the invention, and can be determined by the effect to be produced; it may be assumed for the present purposes that alternate dial needles are projected and retracted to knit at one feed and that the intermediate dial needles are projected and retracted to knit at the other feed.

The needles **6** and **7** are to produce patterns or other fancy effects in the fabric and hence constitute the major number of the needles of the cylinder needle bank, for example all except for the few special needles referred to again hereafter. A cam race **8** connects the exit or stitch cam end of the feed of Fig. 3 with the entrance end

of the feed of Fig. 2, and a similar race 8*a* connects the exit or stitch cam end of the Fig. 2 feed with the entrance end of the Fig. 3 feed. In the present instance the long and short butts of the needles 6 and 7 are used to cause the cylinder needles to form tuck stitches in lieu of knit stitches on occasion and at certain places in the fabric; it will be understood from the foregoing however that the invention is not limited to a tuck and knit stitch variation, but is applicable to any sort of variation of knitting operations that may be desired. To produce this knit and tuck variation at the Fig. 2 feed, there is provided at this feed a cam 9 suitable to raise both long and short butt needles 6 and 7 to a height where the loops on the needles drop behind the needle latches (assuming latch needles) and hence produce knit stitches. A cam 11, suitable to engage with the long butts of needles 6 but so thin that it passes the short butts of the needles 7 without striking them, serves, when active, to raise the long butt needles from the race 8 level to the cam 9. Below the cam 9 a race 12 is provided by a cam 13 which is capable of raising any cylinder needle the butt of which enters the race 12, to such a height that the needle latch is opened, but not high enough to clear the old loops below the needle latches, and hence cause tuck stitches. Back of the cams 9 and 13 the butt-engaging surface 14 of a stitch-cam 16 retracts both the long and short butt needles sufficiently to cast-off, and from 15 below the stitch cam 16 the needles may be raised to the rest race 8*a* as is customary.

Between the outlet end of rest race 8 and the cams 9 and 13 is provided a gate cam or pair of cams 17 and 18 coupled together for simultaneous movement lengthwise of the needles. These cams 17 and 18 are thick enough, in the arrangement of Fig. 2, to engage the butts of all needles of the cylinder bank and are so shaped as to cause the butts of needles coming to them to pass between them, regardless of whether they are in their upper or their lower positions. Accordingly when this gate cam or cam pair 17—18 is in its lower position, shown in full lines in Fig. 2, all needles coming from the rest race 8 are directed to the thin cam 11, with the result that the long butt needles 6 pass over the cam 9 and hence form knit stitches, and the short butt needles 7 pass into the race 12 and hence form tuck stitches at this feed of Fig. 2. On the other hand when the gate cam or cam pair 17—18 is in the upper position, indicated by broken lines in Fig. 2, all the needles leaving the race 8, both long and short butt, are raised by the cam 17 to lengthwise positions where all of them pass over the cam 9 and hence all form knit stitches at the feed of Fig. 2. Hence the gate cam 17—18 is able to direct needles to the race 12 or to the race above the cam 9 as the operator of the machine may desire. These two races constitute, as it were, alternative races for the butts of the stitch-forming elements.

The camming at the feed of Fig. 3 is the reverse of that at Fig. 2, as it were. That is to say, the outlet end of rest race 8*a* has cam surfaces 19 and 20 which deliver all needles at such a height that (except for the gate cam) all needles will pass onto the cam 22 which corresponds generally to cam 9 of Fig. 2, i. e. is thick enough to engage both the long and short butts and raise needles to knitting positions. Below this cam 22 is a race 24, the lower cam 25 of which is thick enough to engage both the long butts and the short butts, and is capable of raising the needles to tuck stitch positions at this feed of Fig. 3. Back of cams 22 and 25, the butt-engaging surface 26 of stitch cam 28 retracts all the needles to cast-off position, and from 27 below it the needles may be raised to their rest positions in race 8, as is customary.

Between the outlet of race 8*a* and the cams 22 and 25 is provided a gate cam or pair of cams 29 and 30 coupled together for simultaneous movement lengthwise of the needles. These cams 29 and 30 are thin cams (or at least 29 is a thin cam) so that the short butts of needles 7 can pass the gate cam 29—30 without being engaged and repositioned by it, but the long butts of the needles 6 are engageable by the gate cam and hence repositionable by it, and caused to pass between the two cams 29 and 30 regardless of whether the gate is in its upper or its lower position. Accordingly when this gate cam or cam pair 29—30 is in its lower position, shown in full lines in Fig. 3, the short butt needles 7 pass over the cam 22 and form knit stitches, but the long butt needles 6 pass to the race 24 and hence form tuck stitches at the feed of Fig. 3. On the other hand, when the gate cam or cam pair 29—30 is in its upper position, shown by broken lines in Fig. 3, all the needles are directed onto the cam 22, and hence all the needles form knit stitches at the feed of Fig. 3.

It follows therefore that by raising or lowering the gate cams, the whole of the face of the fabric that is made by the cylinder needles 6 and 7 may be composed of knit stitches, or may be composed of a mixture or mixtures of knit and tuck stitches, or may be composed in part of a mixture of knit and tuck stitches and in part of knit stitches alone.

A conventional mechanism for shifting the gate cams is shown. That is, the cams 17 and 18 are mounted on a vertical rod 32 that is slideable lengthwise in the cam cylinder 3 and which is provided with a horizontal pin that rests in a sinusoidal slot 35 in the edge of a disc 34. The disc 34 is rotatable on the upper edge of the cam cylinder 34 and has attached to it a star wheel or series of radially projecting arms 36. A bob-pin 38 having a head 37 is raised and lowered under the control of a pattern chain 40 which is advanced around a pulley at 42. Normally the head 37 is below the path of the star wheel 36, as shown in Fig. 1, and thus has no effect on the gate cam 17—18, but whenever the pattern 40 raises the bob pin 38, the head 37 is placed in the path of the star wheel 36 so that as the cam cylinder 3 rotates the star wheel is caused to strike the head and thereby turned one step. If the gate cam 17—18 is in its lower position, this action moves it to its upper broken-line position; if it is in its upper position, the action restores the gate cam to its lower full-line position. The gate cam or cam pair 29—30 is mounted and shifted similarly, by the same bob pin 38, as will be recognized from Figs. 3 and 1. If desired, the pattern chain 40 may be advanced at such a rate or at such times that the gate cams of the two feeds are shifted alike, or shifted independently of each other.

In the present instance the present invention is applied to permit the shifting of the gate cams without endangering the needles. To this end the cylinder needle bed 1 is provided with a few, say four, special needles 44. These are located adjacent the bob pin 38; more specifically, at the part of the needle bed whereat the shifting of the gate cams occur under the direction of the bob pin 38. These needles have no butts within the path of any of the cams of the regular cam system previously described. Accordingly either gate cam can be shifted, either up or down, while passing over this group of special needles 44 without danger of leaving a needle misplaced in a position where it can be struck later by a cam head-on and thereby damaged. Below the regular cam paths, or speaking more generally, displaced lengthwise of the needles, the special needles 44 are provided with butts 45 and two cams 46 are added to the cam ring 3, one at each feed, to engage these butts and raise the special needles to clearing positions at the respective yarn feeds. Accordingly the special needles 44 take yarn from whichever feed is passing at the moment, and being retracted form knit stitches. A stitch cam 47 is added to the cam ring at each feed, at an appropriate place back of the adjacent raising cam 46, to retract the special needles to complete their stitches, acting on the butts 45 of the special needles. By this arrangement accordingly the gate cams can be shifted safely without the occurrence of an unknitted strip of fabric at the shifting position, and without any need of slowing the speed of rotation of the cams when a gate cam is to be shifted either up or down, provided the group of the special needles 44 is sufficiently large to permit the shift to occur while the gate cam is passing over the group.

The modification of this arrangement shown in Fig. 6 permits the elimination of the special stitch cams 47 for example. In this modification each of the special needles 48 is provided with a butt 49 so disposed as to run in the regular cam races, but which is shorter than the short butts of the needles 7. The regular cams such as 9 and 16, 17, 18, etc., may be as described with reference to Fig. 2, and thick enough to engage and act on the extra short butts 49, except that the cam 11 is continued thin so as to act on only the long butts of the needles 6 and the shiftable cam, e. g. 18, and if necessary the lower end of the guard cam which is above the needle projecting cam 9, are made so thin that the extra short butts 49 are outside the paths of these latter cams, i. e. these

cams pass them without engagement; or to this end they may be cut back or thinned at their lower portions, say to the lines 50, so that the extra short butts 49 can pass them without engagement under all conditions. The projecting cam 51 for the special needles 48 then is arranged to, say, raise the special needles so that their butts 49 pass from the race 8 onto the cam 9. This cam 51, similarly to the cams 46, is displaced, lengthwise of the needles, from the regular cams 9, 11, 17, 18, etc., i. e. in the present instance is placed at a lower level than the regular cams. With such an organization the regular stitch cam 16 serves to retract the special needles to complete their stitches, thereby eliminating the need for the special stitch cam 47 of Fig. 2. Other possible variations along this line are obvious.

Speaking generally, any arrangement whereby the special needles (or whatever the stitch-forming elements may be) are caused to perform knitting operations independently of the shiftable cam or cams, is sufficient for the present purposes. This fact is further illustrated by the modification shown in Figs. 4 and 5. Here the special needles 52 are provided with butts 53 so placed as to run in the regular cam races and be actuated by the regular cams other than the shiftable cams, but which are longer than the butts of any of the other needles, speaking generally. A cam 54 is provided to act on the butts 53 to project the special needles 52 to, say, knitting position, but which is too thin to engage with the butts of the other needles. As indicated, this cam 54 can be placed between the wall of the cam cylinder and a shiftable cam 55 for the regular needles 56. The shiftable cam 55 is so placed as to act on the butts of the regular needles 56, but in no position able to engage the butts of the special needles 52; e. g. all the positions of the shiftable cam 55 may be below the position of the special needle cam 54, as indicated in Figs. 4 and 5. It will be evident that with this construction also the shiftable cam 55 can be shifted in position without danger to the needles, providing the group of special needles 52 is sufficiently large. A stitch cam for all the needles is shown at 57, and dial needles at 58.

It will be understood that my invention is not limited to the particular constructions, details and operations shown in the drawings and described above, except as appears hereafter in the claims, and that the claims are intended to include equivalents of the elements named in them, as well as those elements themselves.

I claim:

1. In a circular knitting machine, a bank of stitch-forming elements, a cam system to actuate said stitch-forming elements, said system providing at least two alternative races for butts on elements of said bank and including a gate cam shiftable to direct said butts to one of said races or the other, and mechanism to shift said gate cam from one of its positions to the other while the gate cam is passing a particular part of said bank, characterized by the fact that at least one stitch-forming element, devoid of a butt within any path of said gate cam, is provided at said particular part of the bank, and a cam is provided, displaced from the remainder of the cam system substantially lengthwise of said elements and angularly in about the same position as said gate cam, to project the said at least one stitch-forming element to initiate knitting operations.

2. A circular knitting machine having a bank of stitch-forming elements, a cam system including a cam to actuate a major number of the stitch-forming elements of said bank through at least a portion of each of respective stitch-forming cycles thereof and which is shiftable in position to change its action on said stitch-forming elements, and mechanism to shift said cam while the cam is passing a particular part of the bank, characterized by the fact that at least one stitch-forming element is provided at said part of the bank which is devoid of a butt that is within a path of said shiftable cam, and mechanism is provided to act on the said at least one stitch-forming element at said particular part of the bank where said mechanism acts on said shiftable cam, to cause said at least one stitch-forming element to perform knitting operations.

3. The subject matter of claim 2 characterized by the fact that said second mentioned mechanism is a special cam.

4. The subject matter of claim 2 characterized by the fact that said second mentioned mechanism is a cam which is displaced from said shiftable cam lengthwise of the stitch-forming elements.

5. The subject matter of claim 2 characterized by the fact that said second mentioned mechanism is a cam which is located angularly at about the same position as said shiftable cam, but which is displaced from said shiftable cam in a direction substantially at right angles to said at least one stitch-forming element.

6. The subject matter of claim 2 characterized by the fact that said at least one stitch-forming element has a butt that is adjacent to but outside the path of said shiftable cam, and said second mentioned mechanism comprises a cam of said cam system that is operable on said butt.

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