Oct. 28, 1941. C. F. MILLER 2,260,579

KNITTING MACHINE

Filed Aug. 15, 1939 2 Sheets-Sheet 1

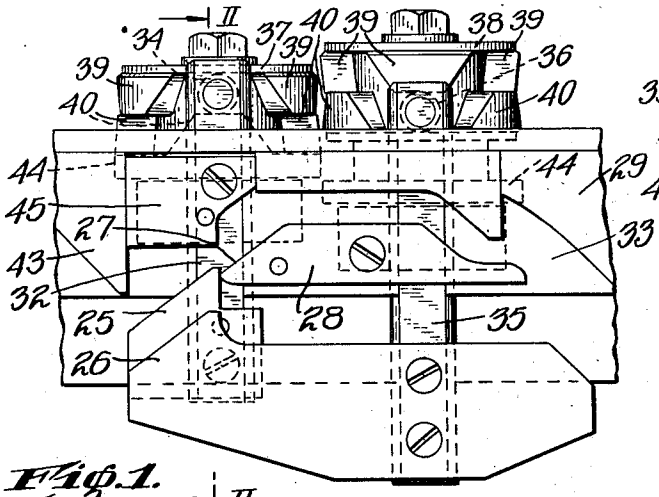


Fig. 1.

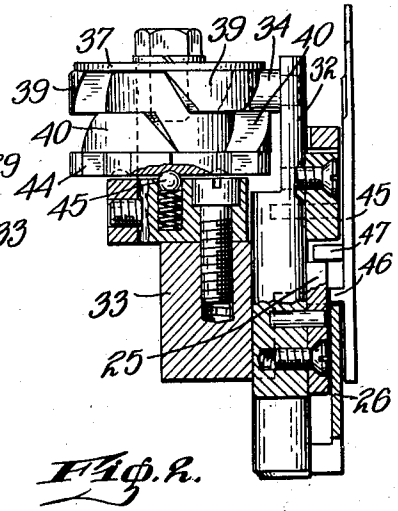


Fig. 2.

Fig. 3.

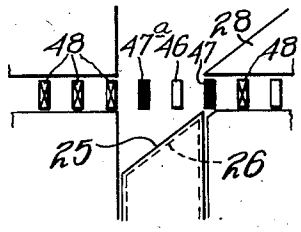


Fig. 4.

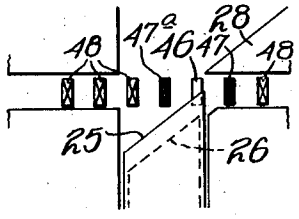


Fig. 5.

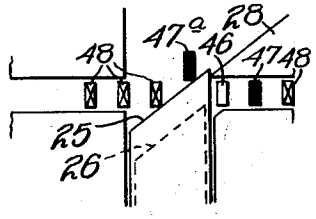


Fig. 6.

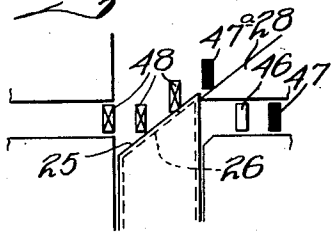


Fig. 7.

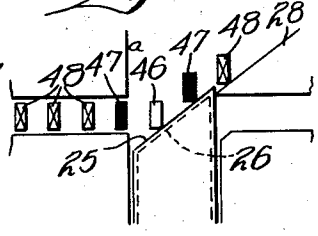


Fig. 8.

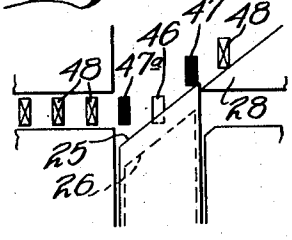


Fig. 9.

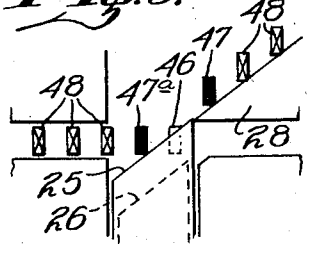
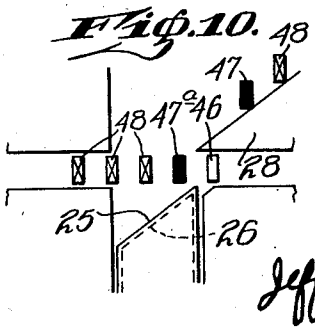


Fig. 10.



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Fig. 11.

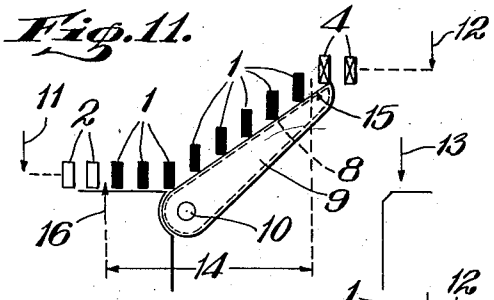


Fig. 12.

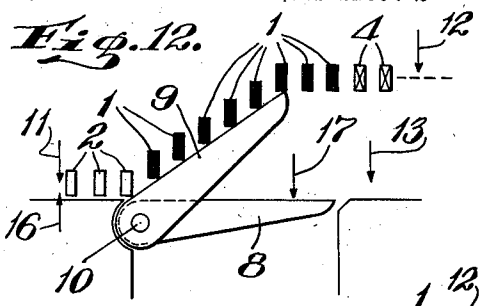


Fig. 13.

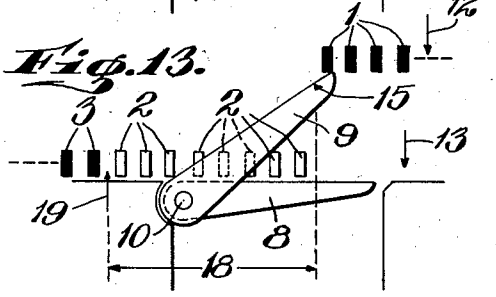


Fig. 14.

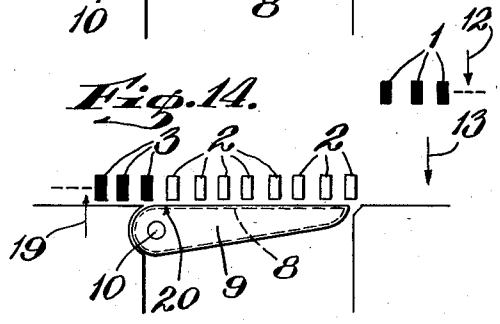


Fig. 15.

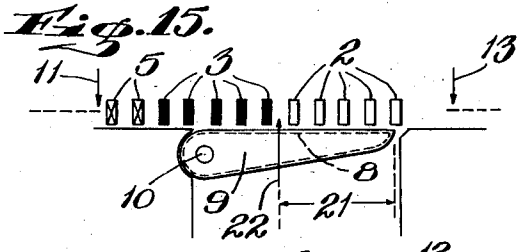


Fig. 16.

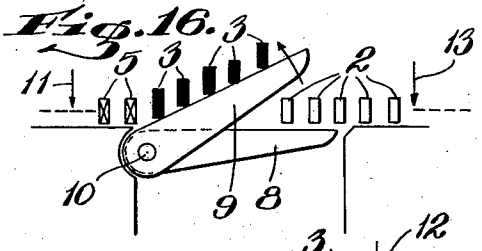


Fig. 17.

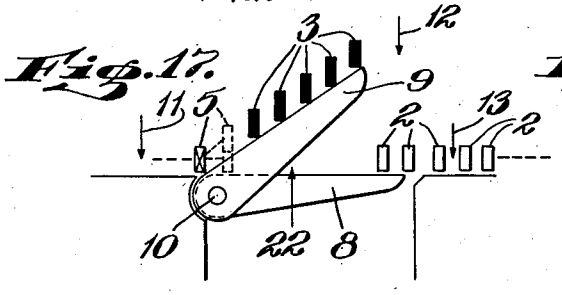


Fig. 18.

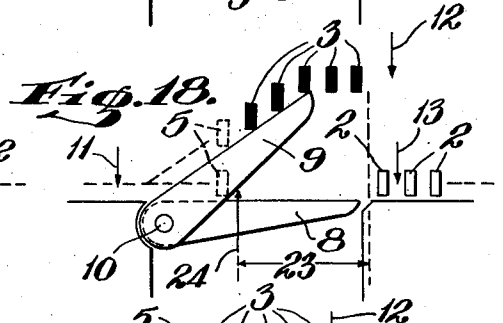


Fig. 19.

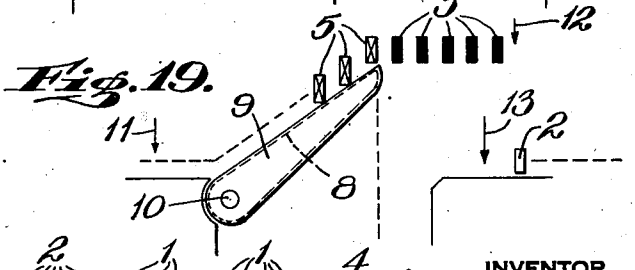
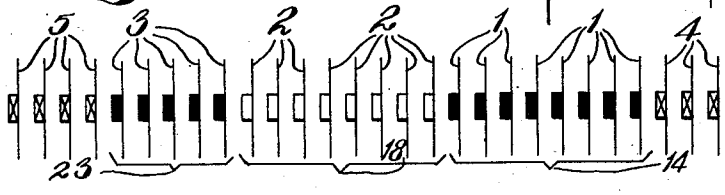


Fig. 20.



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UNITED STATES PATENT OFFICE

2,260,579

KNITTING MACHINE

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Application August 15, 1939, Serial No. 290,149

11 Claims. (Cl. 66—40)

My invention relates to the cams for operating stitch-forming elements of knitting machines, i. e., needles, sinkers, pressers, warp- or wrap-thread guides, etc. For brevity, I refer hereinafter, for the most part, to only the raising of needles; the use of my invention for other purposes and its application to other knitting machine instruments will be apparent therefrom. Also for brevity, I refer hereinafter to only machines in which the needle bank is stationary and the cams move over the needle bank; the application of my invention to machines in which the cams are stationary and the needle banks move will be understood therefrom.

In various circumstances the position of a needle-raising cam must be changed from time to time to direct the needles to or to permit them to pass at different levels. Usually however, no change can be made in the position of a cam while the cam is actually passing over needles, for the reason that movement of a cam from one position to another while needles are passing over it would cause one or more of the passing needles to be placed or left at some intermediate level, e. g., neither at the high level to which the cam directs them when in one position nor at the lower level at which they pass when the cam is fully in its other position. In flat or straight bar knitting machines therefore it has been customary to change cam positions only at the ends of the machine, and in circular machines it has been customary to omit a number of adjacent needles from at least one portion of the needle bed and to make all adjustment of the cams at this one position whereat no needles operate. In some instances at least these practices are objectionable.

Briefly, my invention enables cams to be moved from one position to another in the midst of a field of and while acting on stitch-forming elements, and accordingly avoids the objections to the prior practices.

In the accompanying drawings which illustrate my invention in various forms: Fig. 1 is an elevation of a cam arrangement for raising sliding latch needles of the cylinder of a circular knitting machine to yarn taking or knit position, which embodies the preferred form of my invention; Fig. 2 is a cross section, partly in elevation, substantially on the line II—II of Fig. 1, showing additionally two needles in operation; Figs. 3 to 10 are diagrammatic representations of the adjustable parts of the mechanism of Figs. 1 and 2 in various positions, illustrating the operation; Figs. 11 to 19 are diagrammatic representations of another form which my invention may assume; Fig. 20 illustrates diagrammatically an arrangement of needles suitable for the camming shown in Figs. 11 to 19.

Referring first to the application of my invention as illustrated in Figs. 11 to 20: At each place along the needle bank where a camming is to be adjusted so as to project needles a lesser distance, e. g., where some camming of the cam system is to be taken partly or entirely out of action, I employ at least two groups of needles of different forms, for example, a group of one or more needles 1 having long butts, and behind this a group of one or more needles 2 having short butts. Also at each place along the needle bank where a camming is to be adjusted so as to project needles a greater distance, e. g. adjusted from an inactive to an active position, I employ at least two groups of needles of different forms, for example, a group of one or more needles 2 having short butts and behind this a group of one or more long butt needles 3. The manner in which the needles differ in form is not of primary importance however, providing they differ in such a manner that different lots of needles are capable of responding differently to different cams; it will be understood therefore that my invention is not limited to long and short butt needles, but that other needle forms are alternatives. It will be apparent too that, for example, the needles 2 may be simply a needle group of special form inserted in a field or bank of needles that otherwise are all alike; or as an alternative, the needles 1 and 3 may be simply needle-groups of a special form or forms inserted in a field or bank of needles that otherwise are all like the needle or needles 2; as still another alternative, it is not necessary that any other given needle 4 or 5 of the needle bank be like any of the needles 1, 2 and 3, and they may differ among themselves, as will become apparent.

Also at each place along the cam system where a camming is to be adjusted to the end that needles will be projected thereby a lesser distance than before, I provide adjustable cam means operable on the needle group 2 particularly and another adjustable cam means operable on the needle group 1 but which is incapable of operating the needle or needles 2 to the same extent. Likewise I provide multiple adjustable cam means where camming is to be adjusted to project the needles to a greater distance. Where the camming is to be adjustable in both directions, a single set of multiple adjustable cam means will serve for both purposes as appears herein. Although other (and some more complicated) caming arrangements are available I may use, for example, two similar swinging cams 8 and 9 hinged at 10, placing the cam 8 sufficiently close to the needle staffs to engage the short butts of the needles 2 and placing the cam 9 close enough to engage the long butts of the needles 1 and 3 but far enough from the needles to pass the short butts of needles 2 without engaging the latter. In the present instance these cams, in

their upper positions, Fig. 11, are intended to raise all needles from a lower path 11 to an upper path 12 (where, for example, they may be high enough to take yarn and clear their old loops below, say, their latches); in their lower positions, Fig. 14, they permit the needles to continue from path 11 to its continuation 13 at the same level. The cams 8 and 9 are movable independently of each other, and can be swung from their upper to their lower positions (and vice versa) automatically by suitable mechanism or by hand through a suitable attachment.

It will be understood that the cams 8 and 9 move along the needle bank continuously (or vice versa), and generally at a constant speed, and that the needles are projected by their butts engaging and sliding up the cam faces when the cams 8 and 9 are raised (Fig. 11). Now in order to permit the camming to be adjusted as to its operating position, it is necessary that each needle group such as 1, 2 and 3, be of at least a certain length, generally dependent on the speed of the cams along the needle bank and the periods or lengths of time required to adjust the cams between their two positions, and it is necessary that the came movements take place at certain definite times. Thus to permit adjustment of a camming to a position where it will project the needles to a lesser extent than before (including adjustment to an entirely inactive position), and referring to the particular construction illustrated for clarity, the length 14 of that part of the needle bank that comprises the long butt needles 1 must be about equal to at least the (horizontal) distance 14 from a point 15 near (say half a needle space from) the delivery end of the long butt cam 9 (when in its original position, Fig. 11) to a point 16 which is spaced away from every point on the short butt cam 8 a distance at least equal to substantially (say half a needle space less than) the distance the cam system moves while the respective point on the cam 8 is passing from its initial (Fig. 11) position through (e. g. to a position below) the new path 11—13 that the needles are to follow; usually the length 14 must not be less than substantially the length of the lot of needles that may be in the process of being projected to the original needle path 12 at the moment the short butt cam 8 starts toward its new position. Thus it will be seen, Fig. 11, that the distance 14 is at least equal to (inasmuch as it is greater than, in the present instance) the length of the lot of five needles being raised by the cams; also it will be seen, comparing Figs. 11 and 12 (the latter showing the parts at the instant the short but cam 8 arrives at its new position), that the cam system as a whole moved along the needle bank a distance equal to three needle spaces while, for example, point 17 on cam 8 was in process of moving from its upper (Fig. 11) position to a position where this point 17 is at or below the bottom of the new needle path 11—13 (Fig. 12), and that the point 16 is spaced from this point 17 a distance that is at least equal to (in the present instance, is greater than) this distance of cam system movement, namely three needle spaces, and that this is true not only with respect to the particular point 17 chosen but also is true with respect to every other point on the short butt cam 8 with which a needle butt might engage. Also (to permit the same camming adjustment) the length 18 of the short butt needle group 2 must be about equal to at least the distance from point 15 near (say one-half a needle space from) the delivery end of the long butt cam 9 (when in its original position, Fig. 13) to a point 19 which is spaced away from every point on the long butt cam 9 a distance at least equal to substantially (say one-half a needle space less than) the distance the camming system moves while the respective point on cam 9 is passing from its initial position (Fig. 13) to a position outside (e. g. below) the new needle path 11—13 (Fig. 14), but usually the length 18 must not be less than substantially the length of the lot of needles that, at any moment while short butt cam 8 is in needle-raising position, may be in the process of being raised by the long butt cam 9 in its original (cf. Fig. 11) position. Thus it will be seen that the distance 18, Fig. 13, is at least equal to (e. g. is greater than) the length of the lot of five or six long butt needles 1 that at any moment may be in process of being raised by the long butt cam 9 (Fig. 11); and also, comparing Figs. 13 and 14 (the latter showing the parts at the instant the long butt cam 9 arrives at its new position), it will be observed that the cam system as a whole moved a distance equal to three needle spaces while the point 20 on cam 9 was in process of moving from its upper position (Fig. 13), to a position where it is at or below the bottom of the new path 11—13 of the needles (Fig. 14), and that the point 19 is spaced from point 20 a distance at least equal to this cam system movement, namely three needle spaces; it will be observed further that the same is true with respect to every other point on cam 9 with which a needle butt might engage. Also to adjust the camming downwardly, the short butt cam 8 is started toward its new position when the first of the short butt needles 2 is substantially no nearer the adjustable camming than the point 16; thus the short butt cam can be started toward its lower position when the parts are in the positions of Fig. 11. The more remote the first of the short butt needles 2 is from the adjustable camming at the instant the short butt cam 8 starts down, the longer the long butt needle group 1 must be, as consideration will show. The long butt cam 9 is to be started toward its new position not earlier than the moment the last of the long butt needles 1 reaches a satisfactorily high position, e. g. the height of path 12. If the starting of the cam 9 toward its new position is materially delayed beyond this moment, the length of the short butt needle group 2 must be increased accordingly (i. e. point 19 placed accordingly more remote, as consideration of the matter will show. Points 16 and 19 coincide in the present instance because cams 8 and 9 are alike and move to their new (e. g. lower) positions at the same rate of speed. In order to permit the opposite adjustment of the camming, that is to say, adjustment to a new position wherein the camming will project the needles to a greater extent (including adjustment from an inactive to an active position), and again referring specifically to the particular construction illustrated for clarity, the length 21 (Fig. 15) of the short butt needle group 2 must be about (say one-half a needle space less than) equal to at least the distance from near the delivery end of the long butt cam 9 when in its initial position (Fig. 15) to a point 22 which is spaced from the delivery end position of cam 9 when in its new position (Fig. 17) a (horizontal) distance equal to the distance the cam system moves while the cam 9 is moving from its initial to its new position. Thus since the cam system

of the drawing advances a distance equal to three needle spaces during the period within which the cam 9 moves from its lower (Fig. 15) to its upper (Fig. 17) position, point 22 is spaced the (horizontal) distance of three needle spaces from the position of the delivery end of the raised cam 9 (Fig. 17). Also (in order to permit the adjustment of the camming in this opposite direction), the length 23 of the long butt needle group 3 (Fig. 18) must be about (say one-half a needle space less than) equal to at least the distance from near the delivery end of the short butt cam 8 when in its initial position (Fig. 18) to a point 24 which is spaced from the delivery end of the cam 8 when in its new position (Fig. 19) a distance equal to the distance the cam system moves while the cam 8 is moving from its initial position (Fig. 18) to its new position (Fig. 19). Thus since the cam 8 rises while the cam system is advancing three needle spaces in the drawings, the point 24 (Fig. 18) is spaced the distance of three needles from the point which the delivery end of cam 8 would occupy were it raised. The long butt cam 9 is to be started toward its new position when the first of the needles of the long butt group 3 is substantially no closer to the adjustable camming than the point 22 (Fig. 15). The short butt cam 8 is to be started toward its new position not substantially earlier than the time the last of the short butt needles 2 leave it (Fig. 18). If the starting of the short butt cam 8 toward its new position is delayed materially beyond this moment, the length of the long butt needle group 3 must be increased accordingly, as consideration will show.

When the adjustable camming is to be adjustable in both directions (or otherwise is to be adjustable in a multiple manner) each needle group must have the greatest length required by any operation in which it takes part; thus in the instance illustrated the needle group 2 need have a length of only five needles to permit the adjustment of the camming for inactive to active position, but requires a length of eight needles to permit the adjustment from active to inactive position; by giving this group 2 the latter length, namely the length of eight needle spaces, the grouping 1, 2 and 3 (Fig. 20) suffices for adjustment of the camming in both directions.

Consideration will show also that the foregoing statements of the required lengths of the different needle groups are subject to minor variation depending on the distance between adjacent needles and the particular instants at which the cams are started to new positions; the claims herewith are to be understood accordingly. Also it will now be evident that the form of the remaining needles 4 and 5 of the machine is immaterial as before stated, provided only that such as are to be raised by the adjustable camming at any time, are of such form as to be raised by one of the cams 8 and 9.

In accordance with the foregoing, the operation of the arrangement illustrated is as follows, assuming that the needle arrangement is that of Fig. 20 and that each cam 8 and 9 moves from one position to another during the period in which the cam system (or more specifically, any chosen point on the cam system) advances along the needle bank the distance of three needle spaces: To take this camming out of action, the short butt cam 8 is started down when the first of the short butt needles 2 arrive near point 16 shown in Fig. 11. While this cam is moving down, only long butt needles 1 are traveling this camming; these long butt needles are raised fully to the intended path 12 by cam 9. Cam 8 reaches its new position before the first of the short butt needles 2 strike any point on the short butt cam 8 that might raise it (Fig. 12), and accordingly all the short butt needles pass directly from path 11 to path 13. When the last of the long butt needles 1 reaches the high level intended for it (e. g. path 12), Fig. 13, the long butt cam 9 is started down. While the long butt cam is moving down, only short butt needles 2 are traveling the camming, and these are passing it at the low level of 13. Cam 9 reaches its new position before the first of the needles following group 2 reaches any point on cam 8 that might raise it to above the level 13 (Fig. 14), and accordingly all needles following group 2 (marked 3 in the drawings, but regardless of whether long or short butt needles) will pass to the path 13 without being raised. To restore the adjustable camming to action again, the long butt cam 9 is started toward its new position when the first of the long butt needles 3 is about at point 22 as shown in Fig. 15; it will be understood that this action can take place either at the same short butt group 2 as that at which the camming was rendered inactive as described above, or at any other station where there is a group of at least five short butt needles 2 and five long butt needles 3. Any short butt needles 2 at this camming at this time passes on to path 13 without being raised; however, any of the long butt needles 3 that may strike the cam 9 during its upward movement, first strike it so far from its delivery end that (Fig. 16) they are delivered fully at the upper path 12 (Fig. 17). As soon as the last of the short butt group 2 has left the cam 8 (Fig. 18), the latter is started up. The needle group 3 now sliding up cam 8 is so long (Fig. 18) that any needle 5 that may strike cam 8 during its upward movement is delivered fully to path 12 also. Accordingly all needles following the needles 3 will pass to the upper path 12 again.

When the alternative needle paths 12 and 13 are separated by some considerable distance, employment of my invention in the manner shown in Figs. 11 and 12 may require a larger number of special needles in some one or more of the groups 1, 2 and 3 than is desirable from other considerations. Also, I prefer slidingly adjustable cams rather than swinging or hinged cams. I prefer therefore the form of my invention illustrated in Figs. 1 to 10. In this form, an adjustable camming 25, 26 directs the needles only part way to one of their intended paths and is supplemented by a fixed cam 28. A space or path for the needle butts is provided back of (e. g. below) the cam 26 through which the butts can pass cam 28 to one of their paths and the adjustable camming serves, in one position, to direct or permit the needles to pass to this byerace and, in another position, to direct the needles to a cam surface 27 of the fixedly mounted cam 28 which completes the projection of the needles to the alternative path. In such an arrangement therefore the adjustable camming is required to move shorter distances than in the arrangement of Figs. 11 to 19 for example, accordingly its elements require less time to make their movements, and accordingly the needle groups 1, 2 and 3 can be shorter and may even comprise but one needle each even though the two alternate paths are spaced a considerable distance apart as shown at 12 and 13 in Fig. 12 for example.

Fig. 1 illustrates a camming for cylinder needles and shows the side of the cam system against which the needles bear. In the present instance the inclined cam face 27 can be assumed to raise latch needles high enough to clear their loops below their latches and take yarn from a yarn guide, although again it will be understood that the invention is not limited to this. The cam 28 is fixedly mounted on a cam carrier, and behind it another fixedly mounted cam or cams 29 return the needles again to a lowered position. In accordance with my preference, this camming also is arranged for needles differing in form by their butt lengths. Accordingly, the cams 28 and 29 are of sufficient thickness and so placed as to act on both the long butts and the short butts. The cam 25 is placed to engage only long butt needles, and the cam 26, placed between cam 25 and the needle bank, engages the short butts. Conveniently, cam 25 is mounted on a post 32 slidable vertically in the cam carrier, e. g. 33, and at its upper end the post 32 is provided with a projecting actuating pin or roller 34, and likewise cam 26 may be carried by a vertically slidable post 35 in the cam carrier and provided with a projecting operating pin or roller 36 at its upper end. Individual slotted or cam wheels 37 and 38 act on the rollers 34 and 36 and thereby position the sliding posts 32 and 35 and their corresponding cams. Each cam wheel 37 or 38 is provided externally with a convenient number, say three, downwardly projecting cams 39, and a similar number of upwardly projecting cams 40 at the intermediate spaces; thus these two groups of cams, in each instance, provide a track for the roller 34 or 36 having alternately high and low stations as will be observed from Figs. 1 and 2. Each of the cam wheels 37 and 38 is rotatably mounted on, say, the cam carrier, and conveniently is provided with a star wheel 44 having, say, as many points as there are stations in the roller track of the corresponding cam wheel (six in the present instance), so that as a star wheel is struck by a projecting member moving along or around the needle bank, the corresponding cam wheel 37 or 38 is thereby turned the distance of one station and thereby the corresponding cam 25 or 26 is either raised or lowered, as will be observed from Figs. 1 and 2; as will be understood, the machine can be provided with, say, a projecting finger or fingers revolving around the machine axis and movable into the levels of the star wheels at will whenever either of the cams 25 or 26 is to be shifted in position. A spring-pressed ball 45 and notches in the face of a star wheel 44 to receive it (or some analogous device) can be used to assure each cam wheel being brought to and held in exactly each of its proper stations between successive movements. My invention is not altogether limited to this type of construction for operating such cams as 25 and 26, but it is a convenient one, and a desirable one since it permits each of the cams 25 and 26 to be moved rapidly between its various positions.

In view of the short distance the long and short butt cams 25 and 26 are required to move, and the rapidity with which each can be moved from its upper to its lower position and vice versa by, for example, the form of their operating mechanisms illustrated in Figs. 1 and 2, each distinctive needle group (corresponding to groups 1, 2 and 3 of Fig. 20), need comprise only one needle. Thus a short butt needle 46 followed and preceded by a single long butt needle 47 and 47*a* are sufficient to permit the camming to be adjusted in both directions at this part of the needle bank; i. e., the form of the remaining needles is a matter of indifference, they may be all long butt, or all short butt, or mixed long and short butts.

The operation of the arrangement of Figs. 1 and 2 is illustrated in Figs. 3 to 10. For clarity of illustration, cam 26 is placed at a slightly lower level than cam 25 in Figs. 3, 6, 7 and 10; it will be understood that actually they may stand at equal levels when in the positions represented in these figures, and the same is true with respect to the camming of Figs. 11–19. To adjust this camming from its lower to its upper position, the star wheel 44 of cam wheel 37 is first turned one step. This is so done that the high butt cam 25 is started upwardly (Fig. 3) at a time when the long butt needle 47 has left it, when in rising it will pass the low butt needle 46 (Fig. 4), and when it will deliver long butt needle 47*a* well onto the supplemental cam 28 (Fig. 5) e. g. thrusting 47*a* upwardly as it rises if 47*a* strikes it before it reaches its upper position. The star wheel 44 of cam wheel 38 is then turned a step so that the short butt cam 26 is started upward substantially as soon as the short butt needle 46 leaves it (Fig. 5), and reaches its upper position (Fig. 6) in time to deliver the first needle 48 onto cam 28; in the alternative (i. e. if the butt of this first needle 48 is long enough to engage cam 25) this first needle behind 47*a* will slide up cam 25 to cam 28. All needles, providing they have butts long enough to engage either cam 26 or cam 25, will now be delivered to cam 28 and hence reach their upper path, so long as the camming 25 and 26 remains in its upper position. To return the camming to its lower position, the star wheel 44 of cam wheel 38 is turned another notch (in the same direction as before), so that the short butt cam 26 is started down as the short butt needle 46 approaches the adjustable camming (Fig. 7) and in time to cause the delivery end of cam 26 to reach its new (lower) position before 46 strikes it (Figs. 8 and 9). Accordingly the short butt needle 46 proceeds to the lower level. As soon as long butt needle 47 has been delivered high enough to engage cam 28 (Fig. 8 or Fig. 9), the star wheel 44 of cam wheel 37 is turned another notch (in the same direction as before) and thereby the long butt cam 25 is returned to its lower position before long butt needle 47*a* can be raised by it (Fig. 10). Needle 47*a* therefore proceeds at the lower level, the camming is now adjusted fully to the lower position, and all subsequent needles following 47*a* will pass to the lower path.

I prefer adjustable camming sliding in the direction of needle projection, as with cams 25 and 26, since this permits its needle-engaging surfaces to, as it were, retreat from the needles as the camming moves, e. g. downwardly, and thus helps to permit a cam to begin its downward movement even as late as the instant a needle is about to strike a cam (Figs. 7 and 9). Also a cam-sliding arrangement provides the same effective length of cam in all positions (compare, e. g., Figs. 4 and 5 with Figs. 15 and 16). Both these features tend to shorten the lengths of the special needle groups.

Usually I attach to the sliding post 32 a guard cam 45 which is thick enough to be engageable by the short needle butts 46 as well as the long butts of the needles 47 and 47*a*. This cam 45 is placed sufficiently far above the long butt cam 25 to

permit the needle butts to pass between the two (Figs. 1 and 2). Its purpose is primarily to prevent needles rising inadvertently. For example, in its lowered position it will serve to prevent needle butts passing below cam 43 from rising inadvertently, for any cause, to a position where the butts may strike the forward point of the cam 28. In some instances, in moving downwardly, it may thrust down partly raised needles and pass them below the point of cam 28.

In view of the fact that any one of the needle groups 1, 2 and 3 may comprise only a single needle (as appears, for example, in Figs. 1 to 10), it will be understood that the word "group" is used herein as referring to a single needle as well as to a plurality of needles. Also it will be understood of course that my invention is not limited to the details of construction and operation described above and illustrated in the accompanying drawings, except as appears hereinafter in the claims.

I claim:

1. In a knitting machine, a bank of stitch-forming elements, a part of which comprises at least one stitch-forming element differing in form from at least one other stitch-forming element comprising a part of the bank behind the first mentioned part, and camming adjustable from an initial to a new position to change the path of the stitch-forming elements of the bank from an initial to a new path, said camming including a first cam means operable on the first mentioned part of the bank but ineffective on the second mentioned part of the bank and a second cam means effectively operable on said second part of the bank, said first cam means being movable toward its new position after said second cam means has started toward its new position, the length of the first mentioned part of the bank being at least equal to substantially the distance from near the delivery end of said first cam means when in its initial position to a point which is spaced from every point on said second cam means a distance at least equal to substantially the distance the cam system moves while the respective point on the second cam means passes from its initial position through the new path for stitch-forming elements, but said length not being less than substantially the length of the lot of stitch-forming elements that may be passing over the first cam means when the second mentioned cam means starts toward its new position, and the length of said second mentioned part of the bank being at least equal to substantially the distance from near the delivery end of the first cam means when in its initial position to a point which is spaced from every point on the first cam means a distance at least equal to substantially the distance the cam system moves while the respective point on the first cam means passes from its initial position through the said new path, but the length of the second mentioned part of the bank not being less than substantially the length of the lot of stitch-forming elements that, at any moment while the second mentioned cam means is in its initial position, may be in the process of being acted on by the first cam means in its initial position.

2. In a knitting machine, a bank of stitch-forming elements, a part of which comprises at least one stitch-forming element of one form and another part of which, behind the first mentioned part, comprises at least one stitch-forming element of another form, and camming adjustable from an initial to a new position to change the path of stitch-forming elements from an initial to a new path, said camming including a cam means operable on the first mentioned part of said bank and another cam means effectively operable on the second mentioned part of the bank but ineffective on the first mentioned part, the first mentioned cam means being movable toward its new position after the second mentioned cam means has started toward its new position, the length of the first mentioned part of the bank being at least equal to substantially the distance from near the delivery end of said another cam means, when in its initial position, to a point which is spaced from the delivery end of said another cam means, when in its new position, a distance at least equal to the distance the cam system moves while said another cam means passes from its initial to its new position, and the length of the second mentioned part of the bank being at least equal to substantially the distance from the delivery end of the first mentioned cam means, when in its initial position, to a point which is spaced from the delivery end of the first mentioned cam means, when in a new position, a distance equal to the distance the cam system moves while the first mentioned cam means passes from its initial position to its new position.

3. In a knitting machine, a bank of stitch-forming elements, a part of which comprises at least one stitch-forming element, a second part of which behind said first part comprises at least one stitch-forming element, and a third part of which behind said second part of the bank comprises at least one stitch-forming element, the stitch-forming element or elements of said second part of the bank differing in form from the stitch-forming elements of the first mentioned and said third parts of the bank, and camming adjustable from an initial to a new position and vice versa to change the path of stitch-forming elements from an initial to a new path and vice versa, said camming including a first cam means operable on the first and third mentioned parts of the bank but ineffective on the second part and a second cam means effectively operable on said second part, the first cam means being adjustable subsequent to the second cam means on adjustment in one direction and in advance of the second cam means on adjustment in the opposite direction, the length of the first mentioned part of the bank being at least equal to substantially the distance from near the delivery end of said first cam means when in its initial position to a point which is spaced from every point on said second cam means a distance at least equal to substantially the distance the cam system moves while the respective point on said second cam means passes from its initial position through the new path for stitch-forming elements, but said length not being less than substantially the length of the lot of stitch-forming elements that may be passing over the first cam means when the second mentioned cam means starts toward its new position, the length of said second part of the bank being at least equal to substantially the distance from near the delivery end of the first cam means when in its initial position to a point which is spaced away from every point on the first cam means a distance at least equal to substantially the distance the cam system moves while the respective point on the first cam means passes from its initial position through

the new path, and also being at least equal to substantially the distance from near the delivery end of the first cam means when in its new position to a point which is spaced from the delivery end of the first cam means when in its initial position a distance equal to the distance the cam system moves while the first cam means passes from its new to its initial position, but the length of said second part of the bank not being less than substantially the length of the lot of stitch-forming elements that, at any moment while the second cam means is in its initial position, may be passing over said first cam means when in its initial position, and the length of the third part of said bank being at least equal to substantially the distance from near the delivery end of the second cam means when in its said new position to a point which is spaced from the delivery end of the second cam means when in its said initial position a distance equal to the distance the cam system moves while second cam means passes from its new position to its initial position.

4. The subject matter of claim 1, characterized by the fact that said second cam means is movable toward its new position beginning at the time when the first of the stitch-forming elements of said second part of the bank is spaced away from every point on the second cam means a distance at least equal to substantially the distance the cam system moves while the respective point on said second cam means passes from its initial position through the new stitch-forming element path, and the first cam means is movable toward its new position beginning at the time when the last of the stitch-forming elements of the first mentioned part of the bank substantially reaches the path of the stitch-forming element preceding it.

5. The subject matter of claim 2, characterized by the fact that the first mentioned cam means is movable toward its new position beginning substantially when the last of the stitch-forming elements of the first mentioned part of the bank leaves it, and the second mentioned cam means is movable toward its new position beginning at a time when the first of the stitch-forming elements of the second mentioned part of the bank is spaced from the delivery end position of the second mentioned cam means when in its said new position a distance at least equal to substantially the distance the cam system moves while said second mentioned cam means is moving from its said initial to its said new position.

6. The method of changing the position of camming in a knitting machine having a plurality of stitch-forming elements of different forms and a plurality of associated cam means operable respectively on stitch-forming elements of said different forms, which consists in moving said cam means toward their new positions successively, and moving each from an initial to a new position while only stitch-forming elements of a form or forms operable by another of said cam means are being delivered from said camming.

7. The method of changing the position of camming in a knitting machine having stitch-forming elements of at least two different forms and at least two associated cam means, respectively adjustable in position by movements in directions substantially parallel to the directions of the movements of said stitch-forming elements, and in which one of said cam means is operable on stitch-forming elements of one of said forms but not on stitch-forming elements of the other form and the other camming means is operable on stitch-forming elements of both said forms, which consists when changing in one direction, in moving said other camming means to its new position while only stitch-forming elements of said one form are passing said associated cam means, and moving said one cam means to its new position while only stitch-forming elements of said other form are passing the associated cam means, and, when changing the camming in the opposite direction, in moving said one cam means to its then new position while only stitch-forming elements of said other form are passing the associated cam means, and thereafter moving said other cam means to its then new position while only stitch-forming elements of said one form are passing the associated cam means.

8. In a knitting machine, a bank of stitch-forming elements having adjacently located stitch-forming elements of different form, a fixed cam operable on all of said stitch-forming elements to actuate said elements to desired positions, a bye-race being provided around said fixed cam through which stitch-forming elements may pass said cam without being actuated thereby, a cam operable on stitch-forming elements of one form but ineffective on stitch-forming elements of another form, and another cam operable on stitch-forming elements of said other form, the said two cams being movable successively between positions wherein they direct stitch-forming elements to said fixed cam for actuation thereby and positions wherein the stitch-forming elements pass to said bye-race.

9. In a knitting machine, a bank of needles including a lot of at least three successive needles in which needles intermediate the ends of said lot differ in length of butt from the end needles of the lot, a fixed needle-projecting cam operable on all the needles of said lot, a bye-race being provided back of said fixed cam through which the needle butts may pass without being projected by said fixed cam, and a long butt cam and a short butt cam, said long and short butt cams being movable successively between positions wherein they project needles to said fixed cam for further projection thereby and positions wherein the needles pass to said bye-race.

10. In a knitting machine, a cam, a longitudinally sliding post on which said cam is mounted, a wheel provided with an undulatory track cammed in the direction of the length of the post, for sliding said post, and means for turning the wheel.

11. In a knitting machine, a long butt cam, a short butt cam adjacent thereto, a sliding post on which the long butt cam is mounted, an adjacent sliding post on which the short butt cam is mounted, two wheels each provided with a cammed track for sliding one of said posts, said wheels being turned in different orders and at different times but one shortly after the other.

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