Nov. 13, 1962 M. LOSERT ETAL 3,063,269

CIRCULAR KNITTING MACHINE HAVING A PATTERNING DEVICE

Filed July 20, 1960 3 Sheets-Sheet 1

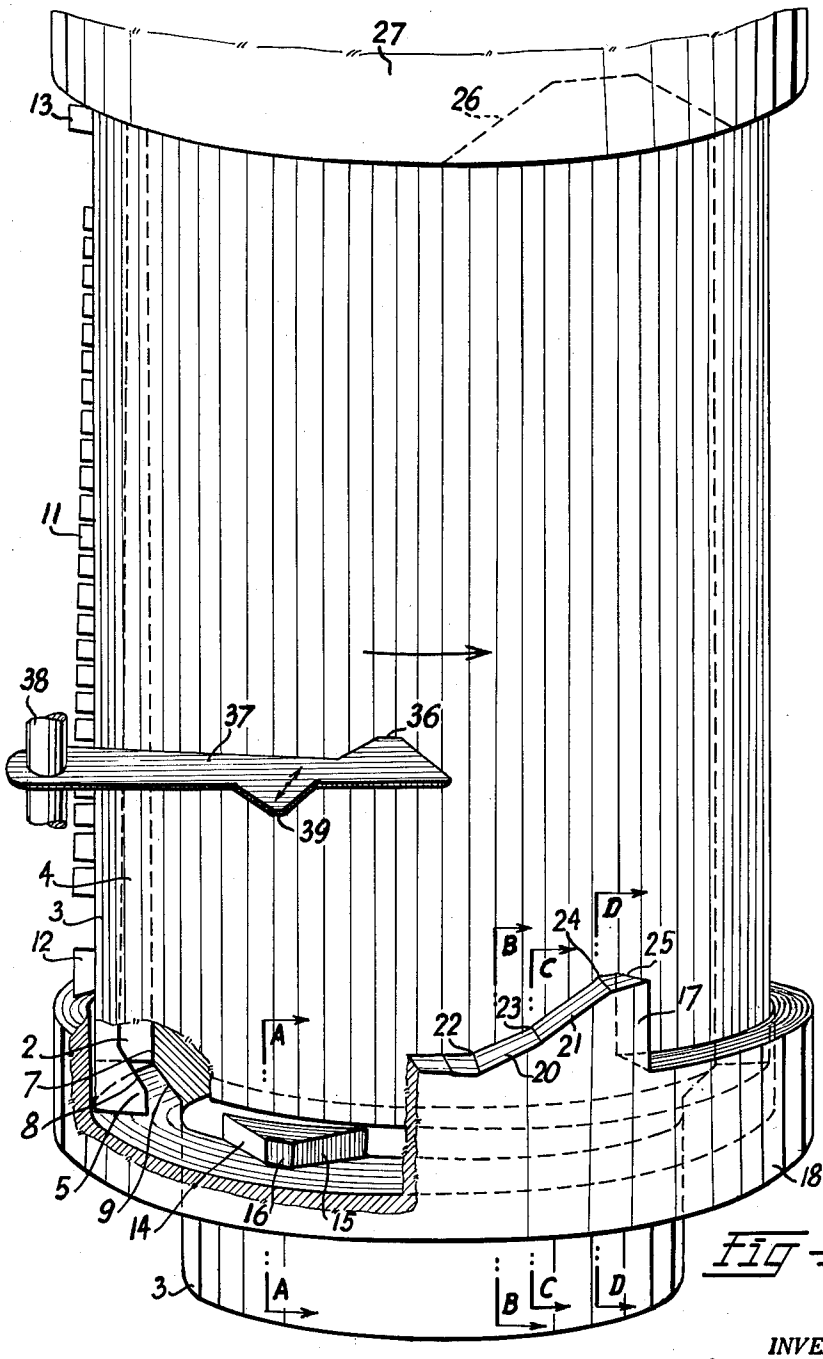


Fig-1

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CIRCULAR KNITTING MACHINE HAVING A PATTERNING DEVICE

Filed July 20, 1960 3 Sheets-Sheet 2

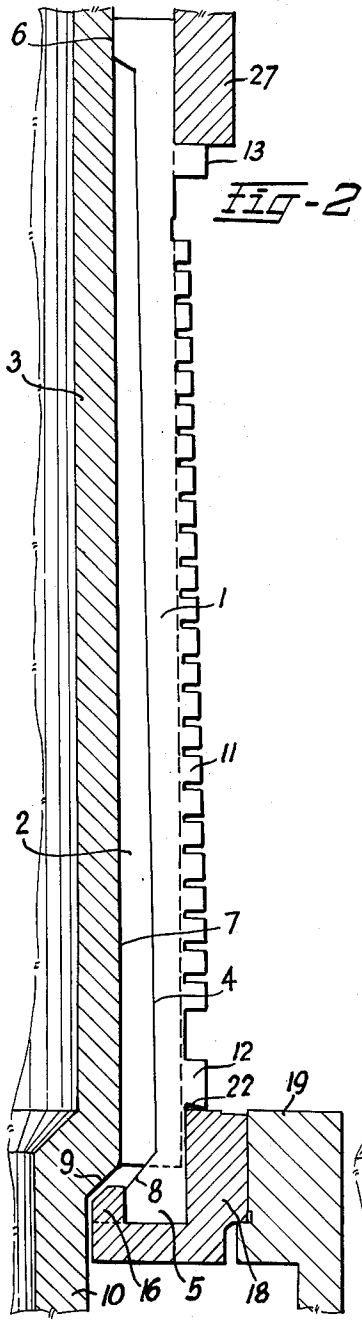


Fig-2

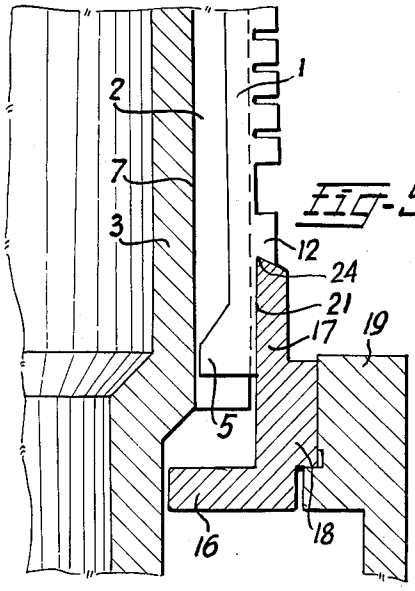


Fig-5

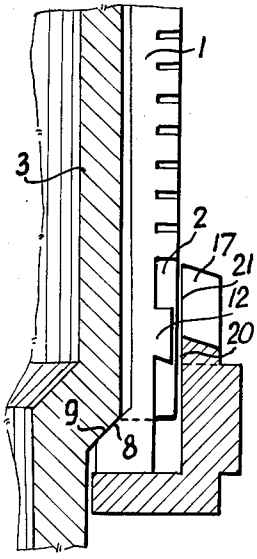


Fig-3

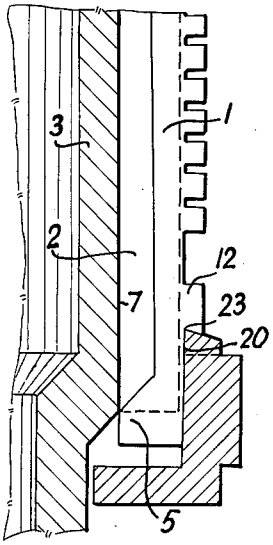


Fig-4

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CIRCULAR KNITTING MACHINE HAVING A PATTERNING DEVICE

Filed July 20, 1960 3 Sheets-Sheet 3

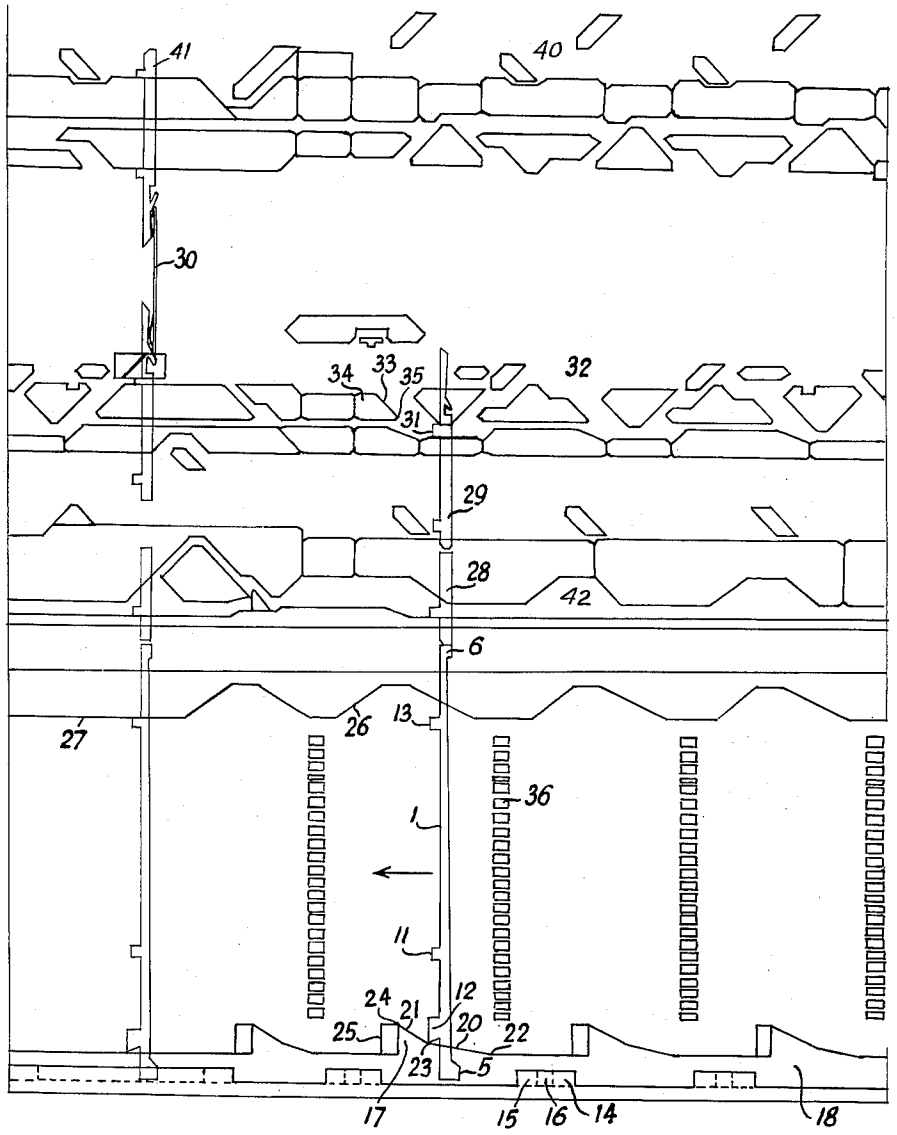


Fig-6

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3,063,269

CIRCULAR KNITTING MACHINE HAVING A PATTERNING DEVICE

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8 Claims. (Cl. 66—14)

This invention relates to circular knitting machines, and is particularly concerned with a pattern mechanism for such a knitting machine which produces patterned hosiery and the like by selective axial movement of needles in the slots of a needle cylinder.

Selector jacks are employed in known pattern mechanisms for moving needles in cylinder slots. The jacks are axially slidable in the needle slots of the cylinder and are equipped with butts which radially project from the slots and are engaged by cams as the cylinder and cams rotate relative to each other during the knitting operation. Engagement between the butts and the cams is selectively controlled by devices which cause the butts to be projected and retracted radially as the cylinder rotates. When a butt does not fully engage a cam, it may slip from the cam which leads to inadequate lifting of the corresponding jack and needle and may cause damage to both. Selector jacks which are arcuately bent in an axial and radial plane have been employed to overcome this difficulty, but they interfere with free movement of the knitting machine elements and cause increased wear.

The primary object of this invention is the provision of a pattern mechanism of the general type described in which the selector jacks are positively positioned by cams.

A more specific object is the provision of a pattern mechanism in which both in the inoperative and in the operative position the selector jacks are positively secured against radial and axial displacement relative to the needle cylinder.

With these and other objects in view, the pattern mechanism of the invention provides a selector jack in each slot of the needle cylinder which is movable in the slot radially between a retracted and a projecting position, and axially between an inoperative and an operative position, and normally is in the retracted inoperative position. The selector jack and the cylinder have cammingly cooperating faces which move the jack from its retracted to the projecting position when the jack is axially moved from the inoperative to the operative position. A cam system is rotatable relative to the cylinder and includes a plurality of cams which are sequentially engaged with the jacks during rotation of the cam system and the cylinder relative to each other. A first cam of the system moves all selector jacks from the retracted to the projecting radial position. A second cam then moves selected jacks back to the retracted position while keeping the remaining jacks in the projecting position. A third cam raises the remaining jacks from the inoperative to the operative axial position, and a fourth cam finally returns the remaining jacks from the operative to the inoperative position.

Other features and many of the attendant advantages of this invention will be readily appreciated as the disclosure is made in the following detailed description of a preferred embodiment of the invention with reference to the annexed drawings in which:

FIG. 1 shows a circular knitting machine in a fragmentary, partially sectional elevational view;

FIG. 2 shows a detail of the apparatus of FIG. 1 in elevational section on the line A—A, on a scale greater

than that of FIG. 1, and as positioned during a different portion of the knitting cycle;

FIG. 3 shows a similar detail in a sectional view on line B—B of FIG. 1, in yet another period of the knitting cycle;

FIG. 4 is a view similar to that of FIG. 3, but taken in section on line C—C of FIG. 1;

FIG. 5 shows a portion of the apparatus of FIG. 1 in section on the line D—D; and

FIG. 6 illustrates the cam system of the knitting machine of FIG. 1 in a developed view on a smaller scale.

FIG. 1 partially illustrates a double-cylinder circular knitting machine. Only the lower needle cylinder 3 is seen. The cylinder has closely spaced axial slots 2 in a portion of its surface and is mounted on a knitting machine frame (not shown) for rotation about its axis as is conventional. A selector jack 1 is inserted in each slot 2 of the cylinder 3, but only one has been shown in order not to crowd the drawing. It will be understood that the other jacks are identical with that illustrated except as specifically stated.

The jack 1 which is better seen in FIGS. 2 and 6, is a relatively long, narrow and thin strip of metal whose longitudinal edges are substantially parallel over a major portion of the jack length, but the lower and upper end portions 5, 6, of the jack 1 project radially toward the cylinder axis when the jack is inserted in the corresponding slot 2, thus defining a recess 4 in the radially inward edge of the jack 1 which faces the bottom 7 of the slot 2.

The narrow edge 8 of the lower end portion 5 in the recess 4 forms a cam face which is obliquely inclined relative to the cylinder axis in a radial plane. In the inoperative lower axial position of the jack 1 seen in FIG. 2, the lower end portion 5 extends downward beyond the slotted portion of the cylinder surface and into radial alignment with a conical portion 9 of the cylinder face which is axially contiguous with the bottoms 7 of the slots 2 and tapers axially in a direction away from the slots 2. The conical cylinder portion 9 is parallel to the corresponding cam face 8 of the adjacent jack 1. Adjacent the conical portion 8, and further spaced from the slotted cylinder portion, the cylinder has a cylindrical portion 10 of reduced diameter.

Each jack 1 carries butts which extend radially outward of the slot 2 in which the jack is inserted. A raising butt 12 is provided closely above the lower end portion 5, and a similar lowering butt 13 near the upper end portion 6. A large number of patterning butts 11 axially aligned between the butts 12 and 13 are formed between short transverse notches in the outer longitudinal edge of the jack. Twenty-four patterning butts 11 are shown in FIG. 1, but it will be understood that this number may be increased at will, and that some of the butts 11 seen in FIG. 1 may be broken away on other jacks as the desired pattern may require, and as is well known.

The rotating cylinder 3 is surrounded by a system of stationary cams supported on the necessary annular bed plates in the usual manner. Only one bed plate 19 is partly visible in FIG. 2 and represents the stationary frame work of the machine, not otherwise shown. A first group of cams is assembled on a lower cam ring 18 which envelopes the lower end of the slotted cylinder portion and the conical cylinder portion 9. As best seen from FIG. 1, the cam ring 18 defines an annular space about the cylinder 3 in which the lower end portion 5 of the jack 1 is free to move radially between the position shown in FIG. 1 in which all butts project outward of the slots 2 into axial alignment with the outer portions of the cam ring 18, this position being hereinafter referred to as the "projecting position," and a "retracted position"

seen in FIG. 3 in which the cam face 8 conformingly abuts against the conical cylinder portion 9 and all butts are withdrawn into the slot 2 and out of axial alignment with the cam ring 18. The end portion 5 of the jack 1 is axially movable in the afore-described annular space between a lower or "inoperative" position illustrated in FIGS. 1 to 3 in which the cam face 8 is radially aligned with the conical cylinder portion 9, and the "operative" position shown in FIGS. 4 and 5 in which at least a part of the lower jack portion 5 is lifted above the conical cylinder portion 9 and is within the slot 2. Because of the camming engagement between the cam face 8 on the lower jack end portion 5 and the conical face portion 9 of the needle cylinder 3, axial movement from the inoperative to the operative position of the lower end portion forces the jack 1 into its projecting position.

The knitting machine shown in the drawing has three feed stations, but elements of only one station are shown in FIG. 1 for the sake of clarity. The feed stations are each associated with a set of cams. A deflector cam 16 is mounted on the cam ring 18 or integral therewith for engagement with an axial face of the end portion 5 when the latter is in its retracted postion. The cam 16 has two cam inclines 14 and 15 which slope radially outward and circumferentially in a radial plane and thus move all jacks 1 which are in their inoperative axial postion from the retracted to the projecting postion, as shown in FIG. 2.

A jack raising cam 17 is angularly spaced from the deflector cam 16 in the direction of cylinder rotation indicated by the arrow in FIG. 1. It is radially adacent the slotted cylinder surface so as to secure the jack in its retracted postion as is seen from FIG. 2. When the jack is in the projecting position, the raising butt 12 moves into the range of the raising cam 17 as is evident from FIGS. 1 and 2. The cam incline of the cam 17 rises from an angular location 22 relative to the cylinder axis to a location 24. An intermediate location 23 defines a lower face portion 20 and an upper face portion 21 on the cam incline. The two face portions are continuous, but differ slightly in their circumferential slope. Both face portions 20 and 21 also slope radially outwardly in a downward direction conforming to the lower cam face of the raising butt 12 with which they cooperate. The descending face 25 of the cam 17 is flat and extends in an axial plane sloping radially outward and forward in the direction of cylinder movement.

Engagement of the jack raising cam 17 with the raising butt 12 of the jack 1 is possible only when the jack 1 is in its projecting position. To select those jacks which are to be raised by the cam 17, there is provided a stack of axially aligned presser cams 36 mounted on respective arms 37 for individual pivoting movement on a post 38 mounted on the knitting machine frame in a manner known in itself. Only one arm 37 with its cam 36 and the corresponding portion of the post 38 are visible in FIG. 1, but it will be understood that there may be as many arms 37 and cams 36 individually pivoted on the post 38 as there are patterning butt positions on the jack 1, as is apparent from FIG. 6 which illustrates the cams 36 in their relationship to the jack 1.

The cams 36 are selectively pivotable toward and away from the slotted cylinder portion for engagement with a corresponding patterning butt 11 at an angular postion of the jack 1 intermediate the deflector cam 16 and the jack raising cam 17. Movement of each arm 37 toward the slotted cylinder portion is actuated by engagement of a cam face 39 on the arm 37 with radially projecting pins suitably secured on the cylindrical surface of a pattern drum or trick wheel mounted on the knitting machine frame for rotation about a vertical axis. Since presser cams and their actuation by pattern drums or trick wheels are known in themselves, only the cam 36 with its supporting arm 37 is shown in the drawing.

An upper cam ring 27 envelops that axial portion of

the cylinder 3 in whose slots 2 the upper end portions 6 of the jacks 1 are axially movable responsive to the camming engagement between the jack raising cam 17 and the raising butt 12. The radial clearance between the bottom 7 of the slot 2 and the upper cam ring 27 is such that the radial position of the upper end portion 6 of the jack 1 is closely determined by abutment against the ring 27 and the slot bottom 7 at all times during the knitting cycle, as best seen in FIG. 2. The radial movement of the jack 1 actuated by the cams 16 or 36 during rotation of the cylinder thus is a pivotal movement centered approximately in the upper end portion 6 which is retained in the slot 2 by the upper cam ring 26.

The lowering butt 13 adjacent the upper jack end 6 projects from the slot 2 at all times for cooperation with a lowering cam 26 seen in FIGS. 1 and 6 which returns the jack 1 to the inoperative axial position after it was raised by the cam 17.

The cooperation of the selector jacks 1 with the needles of the knitting machine and essentially known other elements further cooperating in controlling axial needle movement are illustrated in FIG. 6 in which the several cam systems of the knitting machine are shown in a developed view in which the cylinders are not visible. Two jacks 1 each having but a single patterning jack 11 are shown in respective angularly spaced postions. The direction of normal jack movement is indicated by an arrow, but it will be understood that the cylinder 3 is also capable of reciprocating rotation when the machine illustrated is to be employed for the knitting of hosiery. The heel and toe portions of a stocking or the like may be produced by reciprocating rotary movement of the needle cylinder 3 in a manner well known in itself.

While during unidirectional rotation the lower jack ends 5 are moved radially outward by the cam inclines 14 of the deflector cams 16 and selectively returned to their retracted positions by the presser cams 36, during the return stroke of the reciprocating cylinder movement the jack ends 5 are moved radially outward by engagement with the cam incline 15 of the deflector cam 16 and returned to the retracted position by the radially inclined descending face 25 of the jack raising cam 17.

An intermediate jack 28 is slidable in each slot 2 of the needle cylinder and abuttingly engageable with the upper end portion 6 for the purpose of producing the desired pattern in the knit goods. A slider 29 extends axially upward from the jack 28 in the slot 2 and cooperates with a double ended latch needle 30. The slider 29 is equipped with a knitting butt 31 which engages a system 32 of lower knitting cams in a manner known per se. The needle is also acted upon by a slider 41 cooperating with an upper needle cam system 40 substantially symmetrical to the lower system 32 and not requiring more detailed description.

The lower cam system includes a needle lifting cam 34, the cam face 33 of which begins at an acutely angular edge 35 of the cam 34 and engages the slider for movement between the positions indicated in the center and on the left side of FIG. 6 respectively.

The aforedescribed apparatus operates as follows:

During each revolution of the needle cylinder 3 in the direction of the arrow shown in FIG. 1, each selector jack 1 with the corresponding intermediate jack 28, sliders 29 and 41, and needle 30 travels over the several cam systems illustrated in FIG. 6 in the direction of the arrow of FIG. 6, that is, from the right toward the left as viewed in the latter figure of the drawing. The selector jacks 1 normally occupy the radially retracted, axially inoperative position illustrated in FIG. 3 in which the jacks are substantially entirely contained within the corresponding slots 2, and the cam faces 8 of the lower end portions 5 abut against the conical face 9 of the needle cylinder 3. Only after engagement with the cam incline 14 of the deflector cam 16 are the jacks moved toward the projecting posi-

tion and thus ready for pattern forming selection. This position of readiness is illustrated in FIG. 2.

The patterning butts **11** of the jacks **1** next move past the presser cams **36** on the arms **37**. The positions of the several arms **37** are determined by the presence or absence of a pin on the corresponding location of the non-illustrated pattern drum or trick wheel which is conventionally rotated in synchronization with the cylinder movement. Where an arm is positioned for engagement of its presser cam **36** with one of the butts **11** of a jack **1**, the jack is returned to its retracted position. Where the absence of a pin on the pattern drum or trick wheel fails to place a presser cam **36** in the path of the butts **11**, the corresponding jack **1** remains in the projecting position.

During continued rotation of the cylinder **3**, the jack raising cam **17** is moved past the radially outward end faces of the raising butts **12** of those jacks which were returned to their retracted position by the presser cams **36** and radially secures the retracted jacks in their normal position. They are simultaneously axially secured by the camming engagement of their cam faces **8** with the conical cylinder face **9**. The corresponding intermediate jacks **28**, sliders **29**, and needles **30** are not acted upon by the upper end portion **6** of the returned jacks.

Simultaneously the raising butts **12** of the remaining jacks **1** which passed the presser cams **36** without being returned engage the cam incline of the jack raising cam **17**, and initially the lower face portion **20**. The intermediate jack **28** is held by its own cam system **42** in such a position that there is an axial clearance gap between the bottom end of the jack **28** and the upper end portion **6** of the selector jack **1** when the latter is in its inoperative position. During the initial axial movement of the jack **1** along the lower face portion **20** of the jack raising cam **17**, the gap is gradually closed and abutting engagement between the jacks is established when the raising butt **12** passes the location **23** in a central portion of the cam incline. During travel of the raising butt **12** between the locations **22** nad **23** at either end of the lower cam face **20**, the lower end portion **5** of the jack **1** moves from the position seen in FIG. 2 to that illustrated in FIG. 4 in which the end portion **5** reaches a condition of incipient radial abutment against the bottom **7** of the slot **2**. From the instant of abutting engagement of the selector jack **1** with the intermediate jack **28**, and during subsequent travel of the raising cam **12** over the upper face portion **21**, the lower end portion **5** of the selector jack **1** is radially confined between the bottom **7** and an inner circumferential retaining face of the cam ring **18** as evident from FIGS. 4 and 5.

While the raising butt **12** moves along the upper cam face portion **21** of the raising cam **17**, the selector butt is raised from the position illustrated in FIG. 4 to that seen in FIG. 5. Its radial position is positively defined by abutting engagement of its lower end portion **5** and its upper end portion **6** with the bottom **7** of the slot **2** and with the internal circumferential retaining faces of the lower cam ring **18** and of the upper cam ring **27** respectively. Its axial position is equally positively fixed by the engagement of the raising butt **12** and the lowering butt **13** with corresponding cam faces of the raising cam **17** and of the lowering cam **26** on the respective cam rings **18** and **27**. An accidental return movement of the selector jack **1** toward the retracted or the inoperative position is safely prevented even if the cams should be somewhat worn.

During movement of the raising butt **12** between locations **23** and **24** over the upper cam face portion of the lifting cam **17**, the selector jack **1** by means of the intermediate jack **28** raises the knitting butt **31** of the slider **29** above the edge **35** of the needle lifting cam **34**. Engagement of the cam face **33** of the latter cam with the knitting butt **31** moves the needle **30** into position for taking yarn. During the critical period of travel of the butt **31** past the angular edge **35** of the cam, there is

continuous axially abutting cooperation between the jack raising cam **17**, the raising butt **12**, the jack **1**, its upper end portion **6**, the intermediate jack **28**, and the slider **29**, ensuring precise positioning of the knitting butt **31**, and positively preventing any damage to the butt by collision with the sharp edge **35**. The selector jack **1** then is returned from the operative position illustrated in FIG. 5 to its inoperative position by the lowering cam **26** on the upper cam ring **27**, and further to the retracted position during the next passage of a presser cam **36**.

If because of wear or other malfunctioning, a selector jack **1** is only partly returned to its retracted position by a corresponding presser cam **36**, its raising butt is at least partly engaged by the lower face portion of the jack raising cam **17**. Since in this stage of jack movement the lower end portion **5** of the selector jack **1** has not yet reached engagement with the slot bottom **7** as shown in FIG. 4, the raising butt **12** which has been partly returned to the slot **2** can still safely slide off the jack raising cam between locations **22** and **23** of the lower cam face portion **20**. The selector jack **1** thus is capable of returning to its inoperative retracted position shown in FIG. 3 before it engages the intermediate jack **28** and actuates displacement of the slider **29**. Once the butt **12** passes the location **23** and enters the upper cam face portion **24** in which the jack **1** cooperates with the needle **30**, engagement of the two end portions **5**, **6** of the selector jack **1** with the slot bottom **7** prevents the butt **12** from sliding off the cam **17** and from return into the slot **2**.

It will be understood that the pattern mechanism of the invention described above in connection with a three-feed double-cylinder circular knitting machine is not limited to the type of machine chosen for the purposes of the disclosure. While the specific embodiment illustrated and described is most useful in the manufacture of multi-color Jacquard hosiery with pearl effects, many other applications will readily suggest themselves to those skilled in the knitting art. The pattern mechanism illustrated is readily adapted by minor modifications for use in a single cylinder dial type rib knitting machine and it may be adapted for use with other machines following the teachings of this disclosure.

Obviously the manner in which axial movement is transmitted from the selector jacks of the invention to knitting needles may be varied in any desired manner, and the number of elements arranged intermediate the selector jack and the needle proper may be increased or decreased as needed. The term "needle means" as employed in the appended claims will be understood to comprise not only the knitting needles themselves, but also those motion transmitting elements which are interposed between the needle and the selector jack.

The foregoing disclosure thus relates to only a preferred embodiment of the invention. It is to be understood that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What we claim is:

1. In a circular knitting machine, in combination, a needle cylinder having an axis and formed with a plurality of circumferentially spaced axially elongated slots; a plurality of axially elongated selector members respectively movable in said slots, each selector member having two axial end portions, a first one of said end portion being movable between a retracted position adjacent said axis and a projecting position remote from said axis, and the second end portion being radially substantially fixed, each selector member being axially movable between an inoperative and an operative position and normally being in said inoperative position with said first end portion thereof in the retracted position; camming cooperating faces on said cylinder and on said

first end portion for moving the latter from the retracted position thereof to said projecting position when the respective selector member moves from the inoperative to the operative position thereof, and for securing said first end portion in the projecting position when said selector member is in said operative position; and a cam system including a plurality of cam means and rotatable relative to said cylinder for sequential engagement of said cam means with said selector members, a first one of said cam means engaging said first end portion of each selector member for moving the same from said retracted to said projecting position thereof; a second one of said cam means being engageable with selected ones of said selector members for returning the respective first end portions thereof from said projecting to the retracted positions while leaving the first end portions of the remaining selector members in said projecting position; third cam means engageable with said remaining selector members for moving the same from said inoperative to the operative position thereof; and fourth cam means for returning the remaining selector members from said operative position thereof to said normal position.

2. In a knitting machine as set forth in claim 1, said slots each having an axially extending bottom face, the cammingly cooperating face of said cylinder including a substantially conical face portion axially contiguous with the bottom faces of said slots and tapering in a direction away from said slots, the cammingly cooperatnig face on each of said first end portions at least partly conforming to said tapering cylinder face portion and abuttingly engaging the same when the respective selector member is in the normal position thereof.

3. In a knitting machine as set forth in claim 2, the cammingly cooperating face of said cylinder including a portion of the bottom face of each slot adjacent said conical face portion, and said cammingly cooperating faces of said first end portions abuttingly engaging said portion of the corresponding bottom face when the respective selector member is in the operative position thereof.

4. In a knitting machine as set forth in claim 1, butt means on each of said selector members, said second cam means being engageable with respective butt means on said selected members for returning the first end portions of the selected members from the projecting to the retracted position.

5. In a knitting machine as set forth in claim 4, said second cam means including a plurality of axially spaced cam members each movable toward and away from a position adjacent said cylinder in which said cam member is engageable with said butt means for returning the respective first end portion of the corresponding selector member to the retracted position thereof.

6. In a knitting machine as set forth in claim 1, a plurality of axially spaced butts on each of said selector members, said third cam means including a cam member engageable with one butt on each of said selector members when the first end portion of the respective member is in the projecting position thereof for moving said selector member from the inoperative to the operative axial position thereof.

7. In a knitting machine as set forth in claim 1, needle means axially slidable in said slots, said other end portion of each selector member abuttingly engaging the corresponding needle means when the latter selector member moves from the inoperative to the operative position thereof.

8. In a knitting machine as set forth in claim 1, retaining means, said third cam means including said retaining means for retaining the first end portions of said selected members in said retracted position while said remaining selector members are moved from the inoperative to the operative position thereof.

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