

[54] **MULTIFEED CIRCULAR KNITTING MACHINE**

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[51] Int. Cl. D04b 9/38, D04b 15/74

[58] Field of Search..... 66/50 B, 42, 25, 171, 180

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[57] **ABSTRACT**

To permit knitting different patterns, for example, with the same color scheme, or fabric pattern, but of different configuration such as front panels of sweaters or the like, Jacquard selectors, such as selector drums, have pattern selectors placed thereon corresponding to the different patterns, and the drums are indexed more than once for each revolution of the machine. The pattern selectors, such as selector jacks, to operate selector plates on the machine, are placed such that the first jacks for the first pattern are placed on a first position of the respective selector drums; the first jack of a second and the subsequent patterns are then placed in the first position of the first drum of a subsequent group, and so on; the second jacks of the first pattern are then placed in the next subsequent positions, respectively, and then the second jacks of the subsequent patterns are placed in the next subsequent positions, and so on, so that indexing of the drums during a portion only of the revolution of the machine will present different pattern selectors to the selector plates, for knitting of different patterns.

4 Claims, 9 Drawing Figures

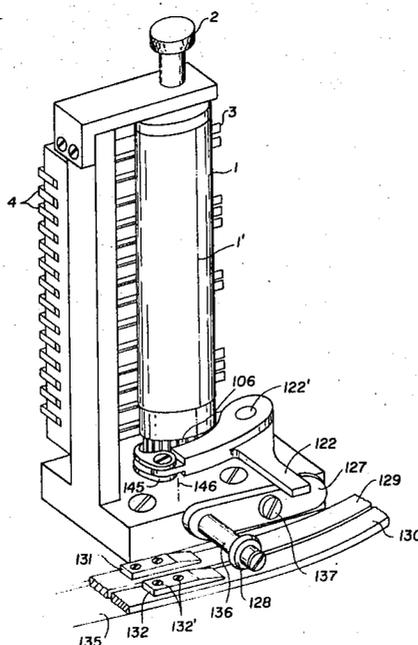


Fig. 1

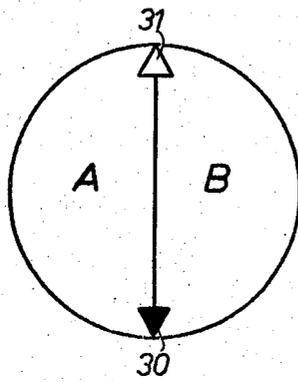


Fig. 5

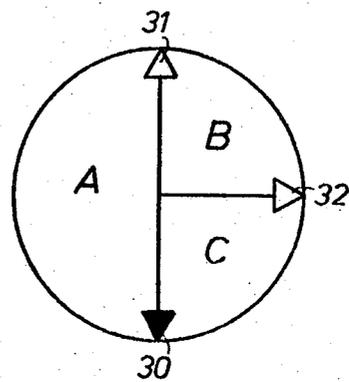


Fig. 4

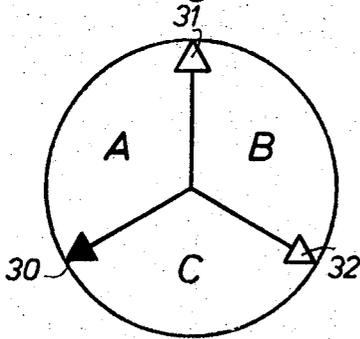


Fig. 2

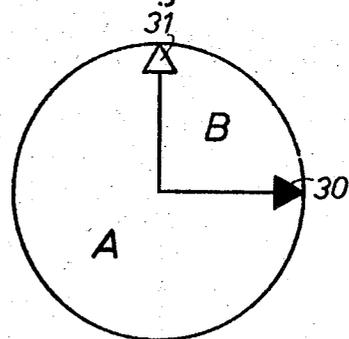


Fig. 6

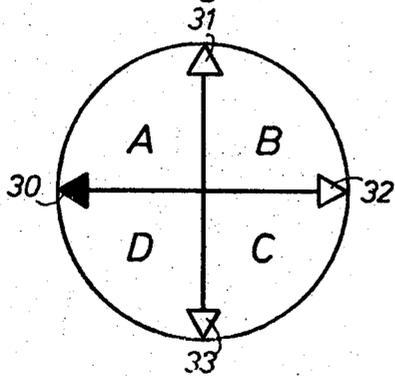
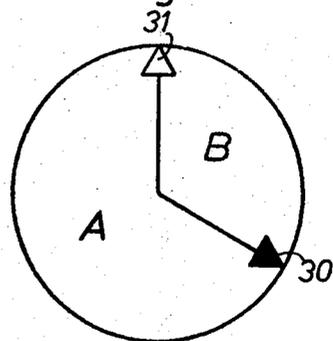


Fig. 3



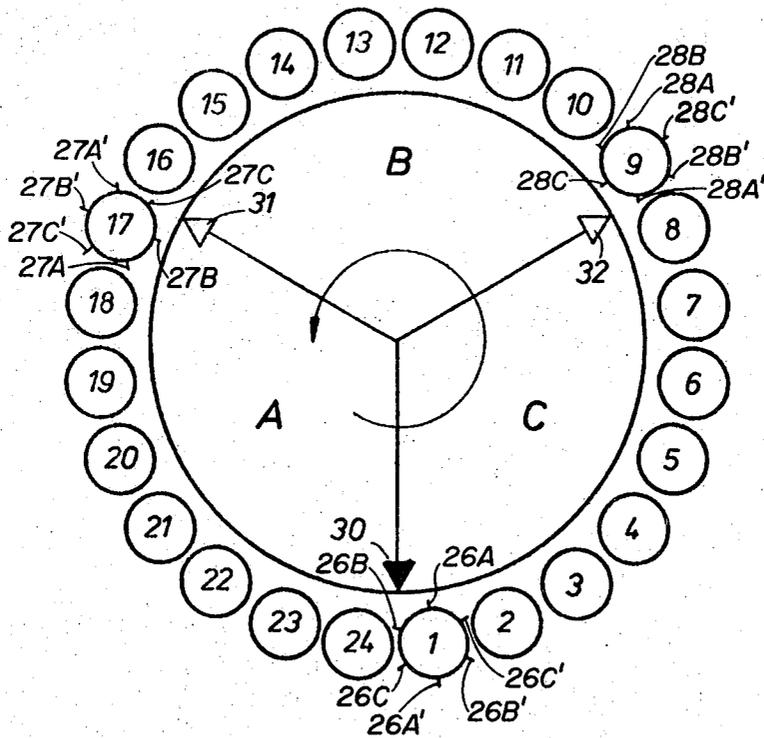


Fig. 7

FIG. 8

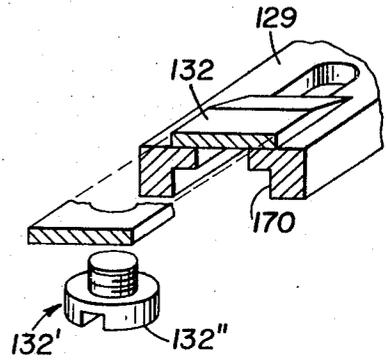
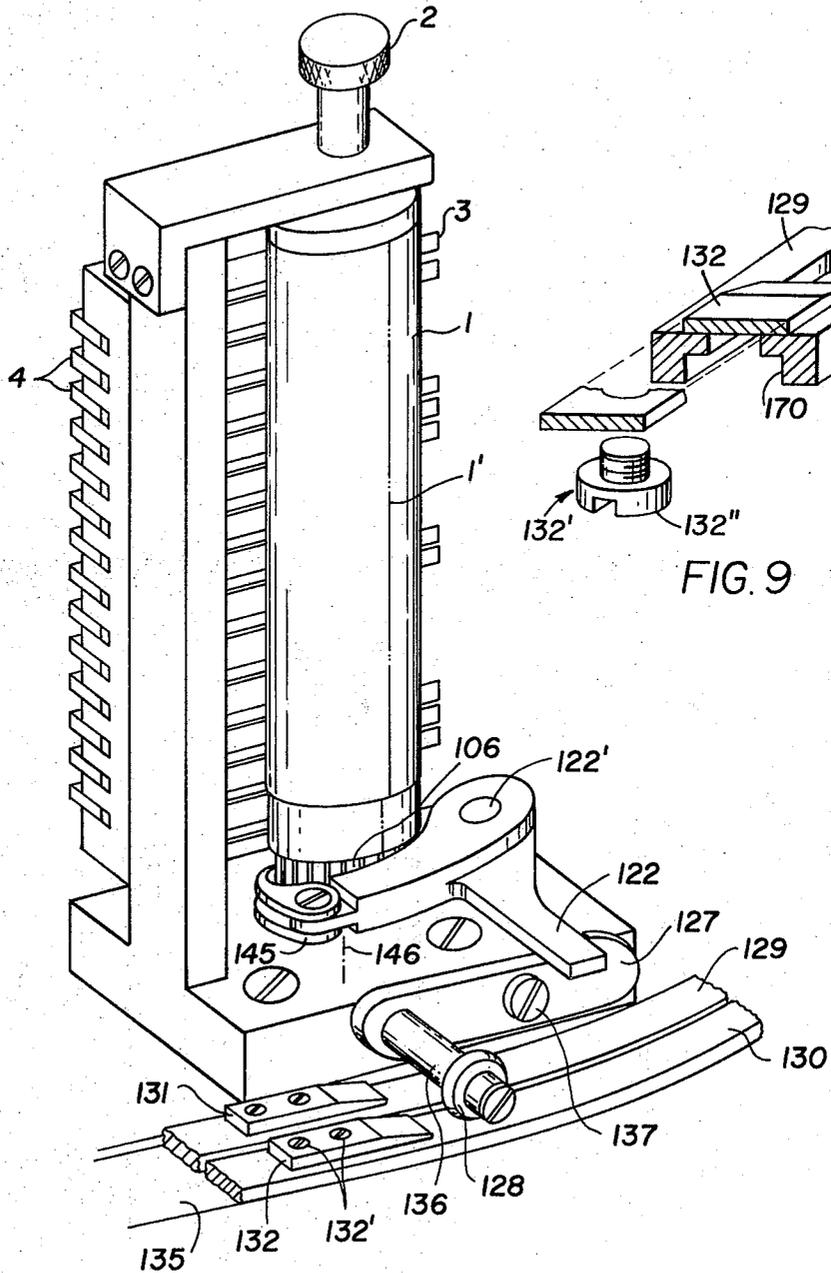


FIG. 9

MULTIFEED CIRCULAR KNITTING MACHINE

The present invention relates to multifeed circular knitting machines and more particularly to knitting machines which are of the Jacquard selector type, particularly to knit various pattern configurations and utilizing similar colored thread, and to a method to knit more than one pattern, with the same color scheme during revolution of a circular knitting machine.

Circular knitting machines having a separate Jacquard selector to control the pattern arrangement of each knitting feed usually are so constructed that the Jacquard selectors are indexed or racked by one or more steps or indexing positions once for each revolution of the machine. This racking or indexing movement of the selector elements, typically selector drums, may be in either direction. Indexing the selector drums effects selection of the pattern for the subsequent machine rotation of each knitting feed, while maintaining the pattern previously selected during the rotation under consideration. These machines then manufacture a tubular fabric which, as known, can provide patterns extending over the width of the machine or, depending on programming, provide patterns which are repeated around the circumference of the tubular fabric, the pattern repeat depending on the diameter and number of needles of the machine. If there is to be a pattern change, then the selector elements, typically selector jacks mounted on patterning drums, or selector pegs projecting therefrom, have to be rearranged or the drums have to be exchanged, which is time consuming particularly if only a portion of the pattern being knitted by the machine is to be changed.

It is an object of the present invention to provide a machine and a knitting method which simplifies the step of pattern selection, and more particularly to obtain tubular fabric which has the same color scheme or color content and fabric type or pattern, which permits the knitting of patterns of different aspects while providing for simple operation of the machine and programming of the pattern selector mechanism.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, the circular knitting machine is provided with patterning arrangements or devices, typically patterning drums having selector jacks or selector pegs thereon, and these patterning devices are, selectively, indexed or racked twice, or more often, for each machine revolution. As a result, selectively, patterns will be made which will have the same color and fabric type distribution but which will be different in the pattern and appearance, the patterns having desired, predetermined widths and appearing, adjacent each other, along the tubular fabric.

In accordance with the invention, the same machine can therefore make two, three or even more sections of fabric having a different pattern appearance, although the type of knitting stitch and the color distribution is the same. This is particularly important for knitting, for example, the front portions of pullovers, sweaters, or the like, which can readily be knitted in the desired eventual size. The number of different patterns that can be made in this manner will, of course, depend on the size of the sweater front portions and the machine diameter. The patterns themselves can be entirely different in their motif or aspect. Thus, articles which have

different pattern appearance but the same color scheme can be made simultaneously on a single machine, without idle time or down time with respect to pattern changing. It would, of course, be theoretically possible to knit sequentially first, several times around on the machine, a pattern of type A; then reprogram the machine and knit a pattern of type B; and then reprogram the machine and knit a pattern of type C. This, however, requires change of the Jacquard selectors for each pattern change. In contrast, and in accordance with the present invention, the Jacquard pattern selectors are programmed once for all three patterns, and the programs for all three patterns are placed on the very same selector drums which, in accordance with the invention, are indexed or racked more than once for each machine revolution. If three patterns are placed on the drums, the drums will be indexed three times for each machine revolution. During the rotation of the pattern selector drum itself, three pattern change points will be formed on the fabric which are about one to two needles wide, which pattern transfer marks can then readily be used as a indication line to cut the tubular fabric, longitudinally, when making the sweaters and assembling the sweater portions together.

If, for example, single color or multicolor fabric patterns are knitted, and the pattern change indications are not desired, then the pattern change, that is, the indexing movement, can be so arranged with respect to machine rotation that it occurs at a time when cylinder needles are not knitting and only the dial needles knit.

The invention will be described way of example with reference to the accompanying drawings, wherein:

FIGS. 1 to 6 are highly schematic illustrations showing different types of combinations to distribute the patterns along the machine circumference;

FIG. 7 is a highly schematic top view of Jacquard selector drums, and their arrangement around the circumference of a circular knitting machine;

FIG. 8 is a perspective illustration of a Jacquard selector drum with the associated selector mechanism, and showing an indexing arrangement therefor; and

FIG. 9 is a sectional view of a modified attachment arrangement for camming elements on the indexing arrangement.

Considering first FIG. 8: a Jacquard selector drum 1, is held in a holder 2, as well known in the art. The drum has selector jacks located along the circumference thereof. The selector jacks have projecting butts 3; drums with pegs or other arrangements may also be used. The butts 3 engage selector plates 4 which engage butts on selector jacks (not shown) projecting from the knitting machine cylinder structure to control projection of the cylinder needles or to inhibit projection, if either a butt 3 is absent or another butt on the jack of the knitting machine cylinder itself has been broken out. This method of controlling needles is well-known, and reference may be had to the later referred to literature references, and, for example, to U.S. application Ser. No. 246,651 filed Apr. 24, 1972 and assigned to the assignee of the present invention.

To index or rack drum 1, the machine has a ring 135 on which one or more cam rings 129, 130 are located. These cam rings rotate with the machine. The cam rings 129, 130 have elevated cam 131, 132 mounted thereon, the cams engaging a cam follower 128 mounted on a shaft 136 which, in turn, is mounted on one end of a lever arm 127, pivoted about a pivot point

137. Lever arm 127, upon being lifted by engagement of cam follower 128 with cam rise 132, releases a latch lever 122 which, by means of a spring, can pivot counterclockwise about a vertical axis 122'. Lever 122 has a ratchet arm 145 connected thereto, movable about a pivot axis 146 (shown schematically). Ratchet arm 145 engages a ratchet wheel 106 to push the ratchet wheel and rack drum 1 by one or more teeth, corresponding to one or more index positions, depending on the position of the arm 145. The pin 136 with cam follower roller 128 is so made that it can be reversed and inserted backwards in a suitable opening in link 127 so that the roller 128 may selectively engage cam element 131 or 132.

The position of the cam follower roller 28 and relative movement of the cam rings 129, 130 will depend on the pattern.

Referring now to FIGS. 1-6: FIG. 1 illustrates division of the pattern into pattern or repeat fields A and B. These pattern fields A, B are controlled by cams 30, 31. Cams 30, 31 are similar to cams 132 for the pattern of FIG. 1, two such cams 132 would be mounted, spaced 180° around the circumference of ring 130, as schematically indicated in FIG. 1. One of the cams is shown in full line position, for example, the cam corresponding to a zero or datum position of the machine, and the other cam 31 is shown open illustrating the division into an auxiliary field. FIG. 2 shows the different arrangement in which one field is three times the size of the other, the cams being offset by 90° with respect to machine circumference; FIG. 3 shows an offset of the cams by 135°; FIG. 4 shows the division into three equal fields A, B, C. Three cams 30, 31, 32, each similar to cam 132 (FIG. 8) are spaced 180° from each other around the circumference ring 130. FIG. 5 illustrates an unequal division with spacing of the cams 90° and 90° apart from each other (leaving 180° from the remaining pattern); and FIG. 6 illustrates division of a circular knitting machine into four pattern fields A, B, C, D, the cams 30-33 being spaced from each other by 90° each. In general, as seen in FIGS. 1-6, the division is $1/n \times 360^\circ$, where n is an integer of 2, 3 or 4. The cams can be selectively placed on ring 130 which, preferably, are formed with pre-drilled holes to secure cams 132 by screws 132' at selected circumferential positions of the rings 129. If infinitely variable adjustment of cam 132 is desired, then elongated T-shaped slots 170 can be cut in rings 129, 130, and screws 132' with a head 132'', inserted from below to permit selected location of cams 132 at any desired circumferential position on the ring 130. Such adjustment, for example, within a certain angular extent, permits infinitely continuously adjustable change of the pattern field.

FIG. 7 illustrates the initial position of the cams 132 with respect to the associated pattern groups A, B, C, if three patterns are to be knitted (FIG. 4) with equally distributed pattern repeats. To be able to make three differently arranged pattern schemes having, however, the same fabric type and the same color distribution, that is, multicolored Jacquard patterns or Jacquard transfer patterns, the selector butts 3 (or equivalent pegs or other devices) of the selector jacks on the drums 1 are suitably distributed around the circumference of the drum 1. For ease of programming, the machine circumference is subdivided into corresponding pattern selection sectors. Each pattern selection sector

is then associated with one of the switching cams 132, that is, with cams 30, 31, 32 (FIGS. 4, 7). The position of the switching cams 132 (FIG. 8), corresponding to cams 30, 31, 32, FIG. 7, with respect to the selector drum 1 will determine the width of the pattern repeat or pattern fields.

Let cam 30 (FIG. 7) be given the designation as main or start switching cam. Cam 30, as main cam, then starts patterning by switching drum 1 of the group A, and the subsequent drums, having a first pattern jack for each subsequent drum (1-24 for a 24 feed machine) located at the first, or datum or index positions. FIG. 7 shows, schematically, 6 pattern jacks per drum. As the cam 31, 32 sequentially impinge on the drum 1, and subsequently on drums 2-24, the drums will be switched to the next pattern B, C, respectively. In the example given, the 24 pattern selector drums are alternately acting for each pattern. The selector jacks in slot (or position) Number 1 & 4, control the Jacquard design of pattern A; the jacks in position Number 2 & 5, control the Jacquard design of pattern B; the jacks in position 3 & 6 control the Jacquard design of pattern C. The jacks associated with patterning A, B and C have been given similar identification letters.

In order to knit three different patterns A, B, C, in accordance with FIG. 7, three different programs, that is, three different sets of selector jacks with selector butts 3 (or equivalent pegs or the like) are so set into the drums 1-24 that the selector jack 26A (FIG. 7) and forming the first jack of pattern A is set at the datum position, for example, in drum 1 and in drums 2-8; the first jack 26B associated with the second pattern, (pattern B) is then set in the next position of drum number 1 and the first jack 26C for the pattern C is set in the third position of drum number 1. The pattern jacks of the three pattern sets (A, B, C) are so set in the drums that they are inserted, according to pattern, in the sequence A, B, C; A', B', C', etc. Each pattern drum is indexed or racked three times for each machine revolution, thus forming three repeat patterns. Since six positions for each drum are shown, the pattern drums 1-24 will revolve once for each two machine revolutions; the jacks which control patterning for the second revolution have been indicated by prime numbers.

Cam 31 controls the second indexing or racking of the pattern drums; thus, jack 27B will be at the index position of drums 17 and jack 28C at the index position of drum 9. The jacks for the other patterns are placed sequentially as shown at 27C, 27A', 27B', 27C', 27A; and 28A', 28B', 28C', 28A, 28B.

The position of a datum point of the indexing drum and the knitting machine, such as a given circumferential line associated with specific butts, and schematically indicated in FIG. 8 at 1', can be varied with respect to the camming system of the machine by shifting the cams 132, either by locating screw 132' in other pre-drilled holes, or by providing for infinitely variable adjustment by means of slots, as previously explained; additionally, or alternatively, the position of the rings 129, 130 may be made adjustable with respect to the machine cylinder and dial, so that the specific location of the cams both with respect to the machine as well as with respect to the Jacquard controller drum 1 is adjustable.

The selector jacks with their butts 3 are, preferably, so set that they will control those cylinder needles to miss which pass by the jacks as the drums index, so

that, during indexing, only the dial needles of the machine will knit. At least a single needle, preferably, is thus disabled from knitting on the cylinder, to provide a separating wale along the fabric to form an easy indication for separation of the fabric into individual patterned fields. Various changes and modifications may be made within the invention concept.

The detailed specification is directed to that portion of the machine in which the apparatus of the present invention is incorporated and with which the method of the present invention is useful. For a complete discussion of knitting machines, reference may be had to "Double Knit Fabric Manual," 1961, "Knitting Dictionary," 1966, "Knitting Encyclopedia," 1972, published by the National Knitted Outerwear Association; "Technologie der Rundstrickerei" by Albert Diebler, Konradin-Verlag, Stuttgart, particularly vols. 9, 10 and 11; "MELLIAND TEXTILBERICHTE," Heidelberg, particularly Vol. 42, issue 12, 1961, pages 1,363-1,370; the various operating and programming instruction books published in connection with sale of the machines referred to in the foregoing publications; U.S. Pat. Nos. 2,169,801; 2,697,336; and British Pat. Nos. 874,719 (which discloses a system to control the dial needles), and 996,291. Well-known parts of knitting machines are described in these references; the cooperation of the apparatus of the present invention with known parts and elements of knitting machines, and application of the invention to other machines and operating elements thereof, will be obvious.

I claim:

1. Multifeed circular knitting machine to knit a plurality of n discrete patterns (A, B, C) located alongside each other on the knit fabric tube having

a plurality of pattern drums (1-24) located around the circumference of the machine and having, each, a datum point;

pattern selector means (3) located on the circumference of the drum with respect to said datum;

racking means (106, 145, 146) to index the pattern drums;

and cam means (131, 132) engaging the racking means to cause indexing of the drums by a predetermined amount;

the improvement wherein

said cam means comprises a plurality of camming el-

ements selectively located around the circumference of the machine and being formed to permit clamping of the camming elements at infinitely continuously adjustable circumferential positions with respect to the cylinder of the machine to adjust the position of the camming surfaces thereof with respect to any specific cylinder needle to index the drums more than once for each machine revolution to permit knitting of fabric having a plurality of different pattern arrangements appearing on the fabric in predetermined widths and adjacent each other, the drums are associated in sequentially positioned n groups (1-8; 9-16; 17-24), first pattern selector means controlling a first pattern (A) being placed, starting from said datum, in first positions (26A) of a first group (1-8) of drums and subsequent pattern selector means controlling further patterns (B, C) being placed on sequential positions (26B, 26C) on the drums of the first group (1-8) of drums, the first pattern selector means (27B, 28C) for each different pattern (B, C) being placed, starting from said datum, in respective first positions of subsequent groups (9-16; 17-24) of the drums, so that any drum has placed thereon in sequential, adjacent positions (26A, 26B, 26C; 27B, 27C, 27A; 28C, 28A', 28B', 28C', 28A, 28B) selector means controlling respective sequential knitted patterns (A, B, C).

2. Machine according to claim 1 wherein the camming elements are located around the circumference of the machine at locations spaced by $1/n \times 360^\circ$, wherein n is an integer of 2, 3, or 4.

3. Machine according to claim 1, having at least one racking control ring (129, 130) rotating in synchronism with machine rotation;

wherein said ring (129, 130) and said camming elements are relatively formed to permit clamping of the camming elements on the rings at infinitely continuously adjustable circumferential positions.

4. Machine according to claim 3 wherein the racking control ring (129, 130) is formed with elongated slots, and screws (132') are provided passing through the slots and engaging the camming elements to clamp the camming elements, said infinitely continuously adjustable positions on said rings.

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