July 21, 1970 M. MEJZLIK ET AL 3,521,467

CIRCULAR KNITTING MACHINE

Filed Nov. 18, 1968 2 Sheets-Sheet 1

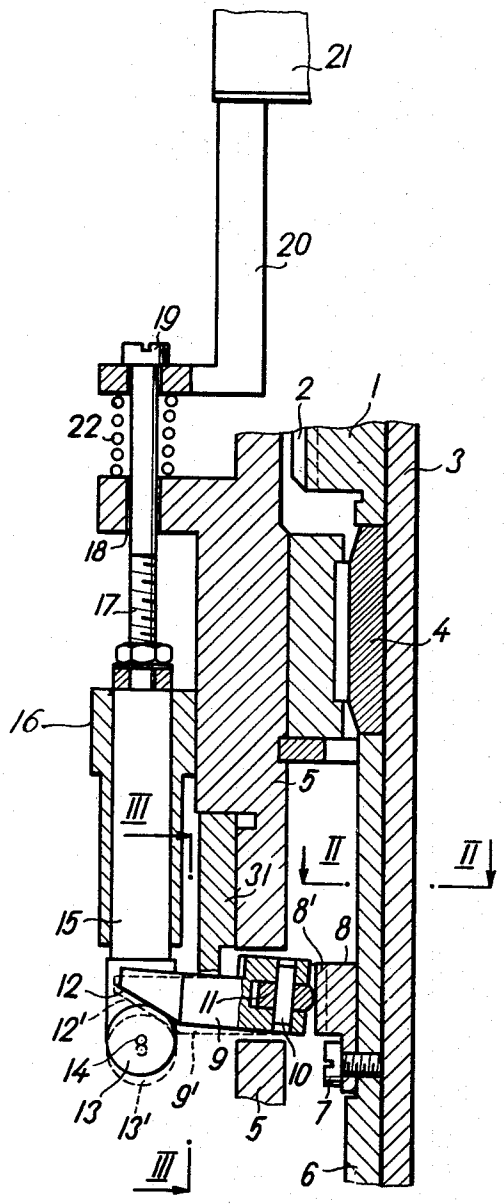

Fig. 1.

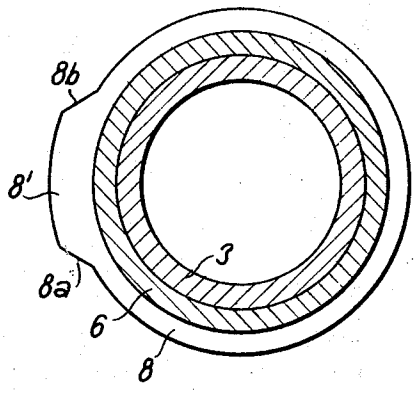

Fig. 2.

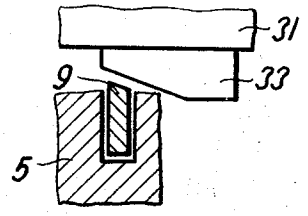

Fig. 3.

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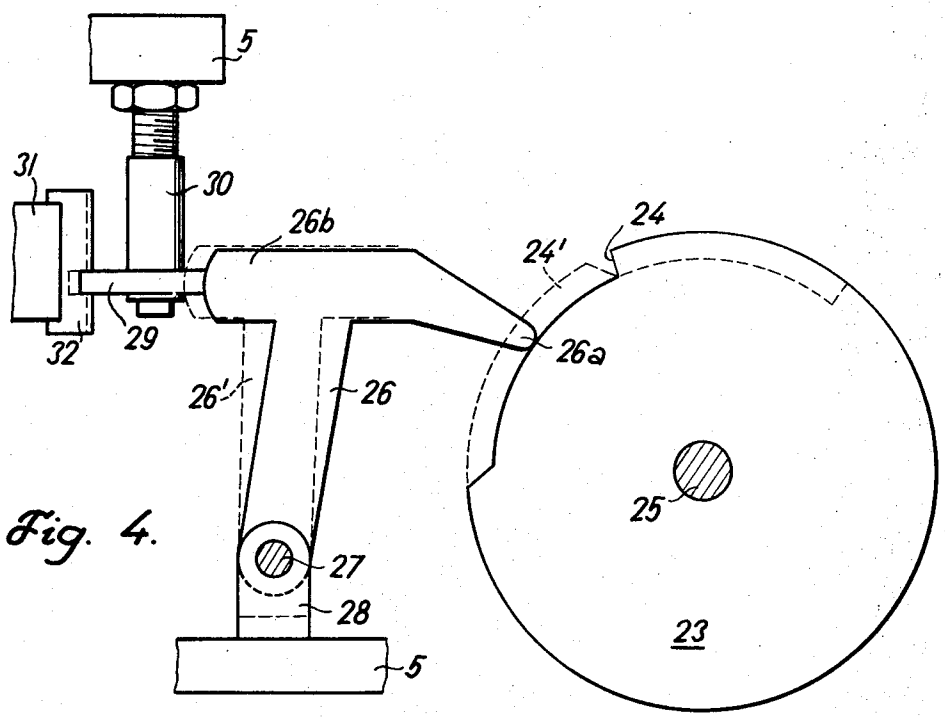

Fig. 4.

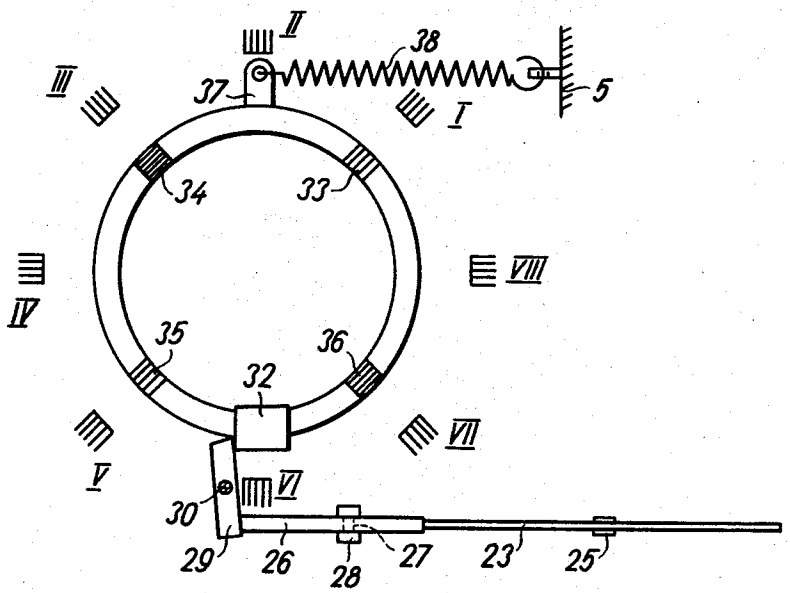

Fig. 5

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CIRCULAR KNITTING MACHINE

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Int. Cl. D04b 15/32
U.S. Cl. 66—54 5 Claims

ABSTRACT OF THE DISCLOSURE

A knitting cam of a circular hosiery knitting machine is shifted axially relative to the needle cylinder by a motion transmitting train connecting the cam to a slide when the slide is pushed in a radially outward direction by a radial cam on the cylinder and is simultaneously shifted axially away from the knitting cam by a shifting cam mounted on a control ring. The ring is oscillated about the cylinder axis in synchronization with the cylinder rotation. The arrangement may be used for making loose stitches in the heel of a seamless stocking.

BACKGROUND OF THE INVENTION

The arrangement relates to automatic knitting cam controls in a circular knitting machine, and particularly to a control device for shifting the range of movement of the knitting needles during knitting axially relative to the needle cylinder, whereby the stitch length may be varied.

It is known to shape the heel in seamless stockings by varying the width of the courses or the length of the stitches in successive courses. By suitable lengthening the stitches in the heel area, the forming of a heel pouch during finishing is greatly facilitated.

The attachments for hosiery knitting machines used theretofore for varying the stitch length in the cyclic manner called for in making a heel pouch are relatively complex and correspondingly apt to require costly maintenance, and they occupy much space in the immediate proximity of the needle cylinder. This is particularly inconvenient in multifeed hosiery machines whose construction, operation, and maintenance are made difficult by the bulky devices clustered around the needle cylinder in the known machines.

The object of the invention is the provision of a control mechanism which permits knitting cams to be moved cyclically in the direction of the needle cylinder axis during only a portion of the knitting cycle for a seamless stocking or the like as is needed for making a heel pouch of the type described, and which is mechanically simple and occupies little space near the needle cylinder.

SUMMARY OF THE INVENTION

With this object and others in view, as will hereinafter become apparent, the invention provides an otherwise conventional, circular knitting machine with a slide which is movably mounted on the machine frame. The frame carries a shifting mechanism which permits the slide to be shifted between an inactive path of movement and an active path. A cam mounted on the needle cylinder cammingly engages the slide during each revolution of the cylinder and moves the slide in either of its two paths between respective inoperative and operative positions. A motion transmitting train connects the slide to an axially movable knitting cam in such a manner that the knitting cam is moved between first and second axial positions in response to movement of the slide in the active path between the inoperative and operative positions, while the knitting cam is held in the first axial position when the slide moves between the inoperative and operative positions of the inactive path.

When the cam on the needle cylinder is a radial cam, the two paths of the slide are substantially radial to the axis of rotation of the cylinder and are axially offset from each other.

In a preferred arrangement, an oblique face of the slide engages a cam follower member of the motion transmitting train which is guided on the machine frame in the direction of the cylinder axis. The slide is shifted between the two paths thereof by a shifting cam whose cam face is obliquely inclined to a radial plane through the needle cylinder axis and is moved circumferentially relative to the slide by an actuating mechanism.

The knitting cam may carry a motion transmitting member which is biased by a spring in one axial direction, whereas the cam follower member carries an abutment which normally engages the motion transmitting member on the knitting cam under the pressure of the spring. The abutment and the cam follower are moved in an axial direction opposite to the aforementioned one direction by the slide member when the latter moves in its active path from the inoperative to the operative position.

Other features, additional objects, and many of the attendant advantages of this invention will readily become apparent from the following detailed description of a preferred embodiment when considered in connection with the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 shows a circular hosiery knitting machine equipped with the knitting cam control mechanism of the invention in fragmentary axial section;

FIG. 2 shows the machine of FIG. 1 in plan section on the line II—II on a reduced scale;

FIG. 3 is a fragmentary sectional view of the device of FIG. 1 taken on the line III—III;

FIG. 4 shows a portion of a shifting mechanism for the apparatus of FIG. 1 in elevation and partly in section; and

FIG. 5 illustrates the cooperation of elements of the shifting mechanism illustrated in FIG. 1 and FIG. 4 respectively in a plan view on a small scale from which much of the knitting machine structure has been omitted for the sake of clarity.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring initially to FIG. 1, there is seen only as much of an otherwise conventional circular multifeed hosiery knitting machine as is necessary for an understanding of this invention. Only the bottom end of the needle cylinder **1** and of one trick **2** is visible in the drawings. The needles which move axially in a multiplicity of respective tricks circumferentially distributed over the cylinder surface have been omitted. The cylinder is provided with a tubular shaft **3** on which a needle bearing **4** is axially secured between the cylinder **1** and a sleeve **6** fixedly fastened to the shaft **3** and thereby to the cylinder **1**. The bearing **4** rotatably secures the cylinder **1** in the supporting frame **5** of the machine.

A radial cam **8**, better seen in FIG. 2, is attached to the cylinder **1** by screws **7** which threadedly engage the sleeve **6**. The cam has a projecting lobe **8'** whose face extends over a circular arc of approximately 45° and is connected by obliquely sloping face portions **8a**, **8b** with the remainder of the cam face which is circularly arcuate, but of smaller radius than the lobe **8'**.

A slide **9** having the shape of a flat bar standing on edge is radially movable with much clearance in an

opening of the frame **5** adjacent the cam **8**. A pin **10** attaches a cam follower roller **11** to the slide **9**. The roller **11** travels over the cam face of the cam **8** during rotation of the cylinder **1**. The end portion of the slide **9** remote from the cam **8** has a cam face **12** which is obliquely inclined relative to the axis of cylinder rotation.

The cam face **12** is in contact with a cam follower roller **13** rotatable on a horizontal pin **14** which attaches the roller to the bottom end of a plunger **15** guided in the direction of the cylinder axis in a guide tube **16**. The tube is fixedly fastened to the machine frame **5**. A long bolt **17** is coaxially threaded into the top end of the plunger **15** and is itself guided in a bore **18** of the frame **5**. The bolt **17** passes through an opening in a bracket **20** depending from a knitting cam **21**, and the head **19** abuts against a top face of the bracket **20** under the pressure of a helical compression spring **22** coiled about the stem of the bolt **17** between the bracket **20** and the frame **5**.

A cylindrical ring **31** is freely rotatable about the axis of the cylinder **1** in a groove of the frame **5** which is downwardly bounded in part by the slide **9**. As is better seen in FIG. 3, the annular bottom face of the ring **31** carries a shifting cam **33** whose cam face is in part obliquely inclined to a plane which perpendicularly intersects the cylinder axis. As will presently be explained in more detail, the ring **31** can be oscillated about the cylinder axis between two positions in which the cam **33** depresses or releases the slide **9**.

In the fully drawn position shown in FIG. 1, the slide **9** is released by the shifting cam **33** and thus is moved by the cam lobe **8'** into an operative position in which it depresses the cam follower roller **13** and the attached guide plunger **15** only so far that the head **19** of the bolt **17** barely touches the cooperating top face of the bracket **20**. The knitting cam **21** is held by the spring **22** in its topmost position which is determined by non-illustrated abutment faces of the stationary machine structure in a conventional manner.

When the slide **9** is released by the cam lobe **8'**, its oblique face **12** slides along the roller **13** radially inward toward the cylinder **1** into an inoperative position. The slide **9** is inactive or without influence on the cam **21** in either position described so far.

When the shifting cam **33** is moved toward the left from the position seen in FIG. 3 and depresses the slide **9** into a path of movement downwardly offset from the afore-described movement, and if the slide is simultaneously moved radially outward into the operative position **9'** indicated in broken lines, its downwardly displaced face **12'** cammingly engages the roller **13** and pulls it into the position **13'** indicated in broken lines in FIG. 1. The bracket **20** is thereby moved axially downward, as partly shown in broken lines, and the cam **21** is shifted into a non-illustrated second position.

As will be obvious, but has not been shown in the drawings, the cam **21** engages butts on the non-illustrated knitting needles in the tricks **2** during rotation of the cylinder **1** and causes axial movement of the needles. As the cam **21** is shifted axially downward, the range of movement of the knitting needle is shifted correspondingly, and the stitch length may thereby be increased.

The actuating mechanism which oscillates the ring **31** into and out of engagement of the shifting cam **33** with the slide **9** is shown in FIGS. 4 and 5. A shaft **25** of the knitting machine drive, not otherwise illustrated, which also turns the cylinder **1** about its axis, carries a radial cam **23** whose otherwise uniformly circular cam face has a notch **24**. The notch extends over an arc of about 60°, and its bottom is circularly arcuate about the shaft **25**, but of smaller radius than the main portion of the cam face.

A cam follower arm **26***a* of a T-shaped rocker **26** travels over the cam face of the cam **23** while the machine operates and the shaft **25** rotates. The rocker **26** is fastened

by a pivot pin **27** to a stud **28** on the machine frame **5**. It has an abutment arm **26***b* which bears transversely against one arm of a lever **29** mounted on the frame **5** by means of a vertical pivot pin **30**. The other arm of the lever **29** engages a stop **32** on the ring **31**, and is held in engagement with the stop **32** by a tension spring **38** which connects a radial lug **37** on the ring **31** with the frame **5** in such a manner as to bias the ring **31** clockwise, as viewed in FIG. 5.

While the cam follower arm **26***a* travels over the main portion **24'** of the cam **23**, as indicated in broken lines in FIG. 4, the rocker **26** assumes the position **26'**, and the lever **29** holds the ring **31** in a position not shown in FIG. 5 in which the cam **33** is out of engagement with the slide **9**. When the cam follower arm **26***a* drops into the notch **24**, the spring **38** can turn the ring **31** into a position in which the cam **33** engages and depresses the slide **9**. The slide is thus depressed into its active path of movement once during each revolution of the cam **23** and of the shaft **25**, and is moved into an operative position once during each revolution of the cylinder **1** by the cam **8**. When the slide **9** reaches the operative position in the active path, it pulls the bracket **20** and the cam **21** down from the position shown in FIG. 1.

As is indicated diagrammatically by Roman numerals I to VIII in FIG. 5, the knitting machine partly shown in FIGS. 1 to 4 has eight feed stations equiangularly spaced on the machine frame about the axis of the needle cylinder, and eight courses of stitches are knitted simultaneously at the eight feed stations respectively by means of cams of which one is identical with the cam **21** at the station I partly illustrated in FIG. 1. The stations III, V, and VIII are equipped with a slide **9** and a motion transmitting train which connects the slide to a knitting cam analogous to the cam **21** in the same manner as shown in FIG. 1. A portion of the structure illustrated in FIG. 1 is thus duplicated three times in the machine. The ring **31** and the cam **8** are common to the several cam control mechanisms, and the ring **31** carries three additional shifting cams **34**, **35**, **36** for depressing the non-illustrated slides at the station III, V, and VII simultaneously with the illustrated slide **9**.

The machine produces alternate courses of regular stitches and of partly loose or lengthened stitches when threaded as implied in FIG. 5. If it is desired to produce a fabric consisting entirely of expanded stitches, yarn is fed only to the four stations I, III, V, and VII.

The number of needles which knit extended or lengthened stitches in each course is determined by the arcuate length of the cam lobe **8'** and may be chosen to suit specific requirements. It will be understood that the shaft **25** is connected to the main drive shaft of the machine by a releasable coupling which permits the cam **23** to be stopped in a position in which the slide **9** and its counterparts at stations III, V, and VII are in their inactive paths of movement, and only normal stitches are knitted although the slide **9** and its counterparts are moved between inoperative and operative positions by the cam **8**. When the slide **9** is in its active position, the lengthened or extended stitches are always knitted by the same needles radially aligned with the cam lobe **8'**. The fabric produced is readily shaped into the heel pouch of a stocking.

The cam control apparatus of the invention has been described above with particular reference to a hosiery knitting machine, but it will be applied readily to other fabrics and knitted objects by those skilled in the art. The specific configuration of the cam **21** is not relevant to this invention. The number of feeds in a knitting machine equipped with the cam control mechanism of the invention may be chosen at will, and the invention is as applicable to a single-feed machine as to a Jersey machine having a multiplicity of feeds. Only very few movable machine elements of great simplicity are needed

for controlling a knitting cam in the manner described above, and these elements occupy but a minimum of space in an area closely adjacent the needle cylinder where they could interfere with other devices of the knitting machine.

We claim:

1. In a circular knitting machine having a frame, a needle cylinder rotatable on said frame about an axis, a knitting cam member mounted on said frame for engagement with needles on said cylinder during rotation of the latter for moving the engaged needles axially on said cylinder, and control means for axially shifting the range of movement of said needles by said knitting cam, the improvement in the control means which comprises:

(a) a slide member movably mounted on said frame;

(b) shifting means on said frame for shifting said slide member between an inactive path of movement and an active path of movement;

(c) cam means mounted on said cylinder and cammingly engaging said slide member during each revolution of said cylinder for moving the slide member in said paths thereof between respective inoperative and operative positions; and

(d) motion transmitting means connected to said slide member and to said cam member for moving said cam member axially relative to said cylinder between a first and second position in response to movement of said slide member in said active path between the inoperative operative positions, and for holding said cam member in said first position while said slide member moves between the inoperative and operative positions in said inactive path.

2. In a machine as set forth in claim 1, said paths being substantially radial relative to said axis and axially offset, and said cam means including a radial cam member on said needle cylinder.

3. In a machine as set forth in claim 2, said slide member having a cam face obliquely inclined relative to said axis, and said motion transmitting means including a cam follower member guided on said frame in the direction of said axis and engaging said cam face.

4. In a machine as set forth in claim 3, said shifting means including a shifting cam having a cam face obliquely inclined relative to a radial plane through said axis and engaging said slide member, and actuating means for circumferentially moving said shifting cam relative to said slide member.

5. In a machine as set forth in claim 3, said motion transmitting means further including a motion transmitting member fastened to said cam member, yieldably resilient means engaging said frame and said motion transmitting member for biasing said motion transmitting member and said cam member in one axial direction, said cam follower member carrying abutment means normally engaging said motion transmitting member under the pressure of said yieldably resilient means, and being moved in an axial direction opposite to said one direction by said slide member when the slide member moves in said active path from the inoperative to the operative position, said active path being offset from said inactive path in said opposite direction.

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WM. CARTER REYNOLDS, Primary Examiner