Dec. 18, 1962 J. BITTLER 3,068,674

CIRCULAR KNITTING MACHINE

Filed July 27, 1960 4 Sheets-Sheet 1

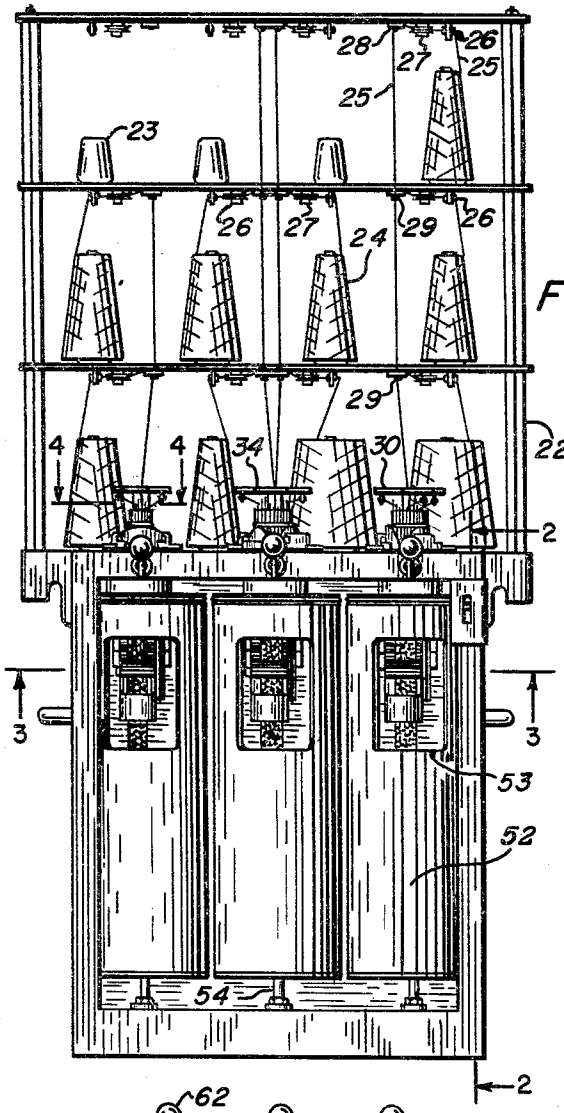


Fig-1

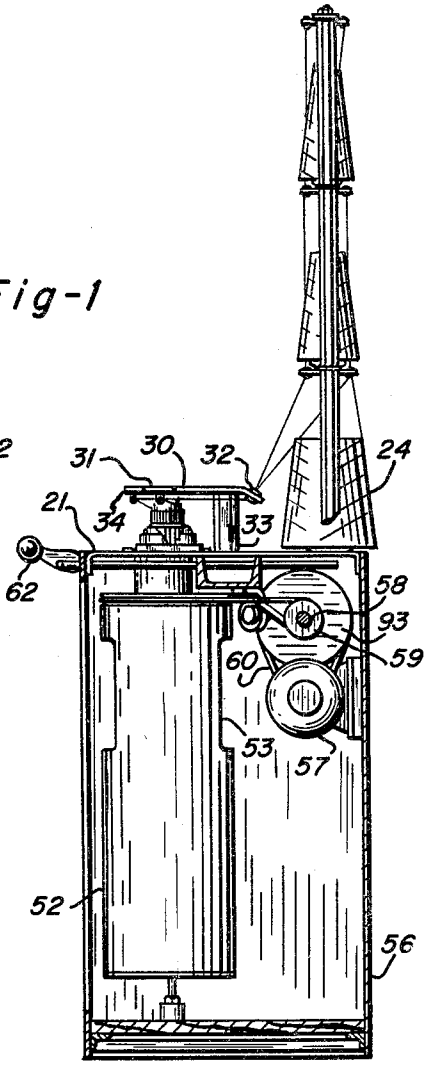


Fig-2

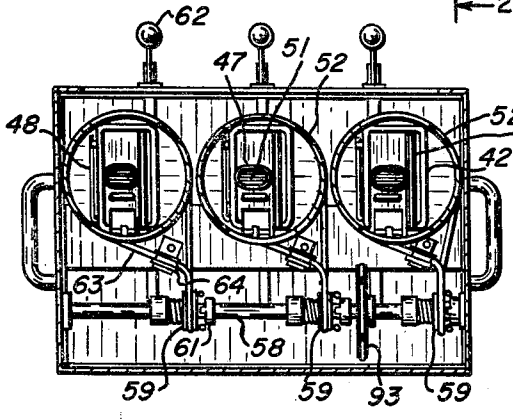


Fig-3

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CIRCULAR KNITTING MACHINE

Filed July 27, 1960 4 Sheets-Sheet 2

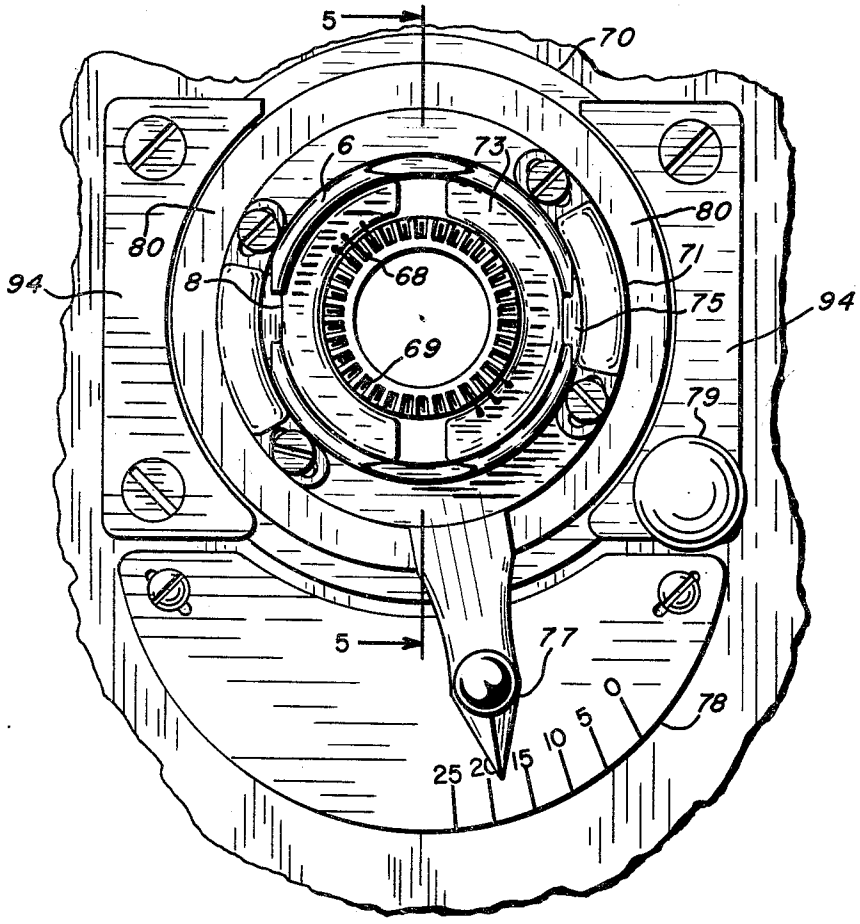


Fig-4

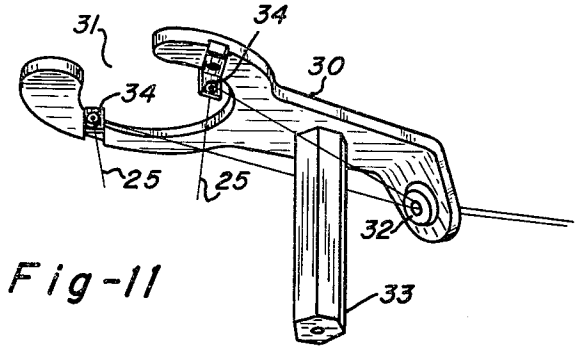


Fig-11

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CIRCULAR KNITTING MACHINE

Filed July 27, 1960 4 Sheets-Sheet 3

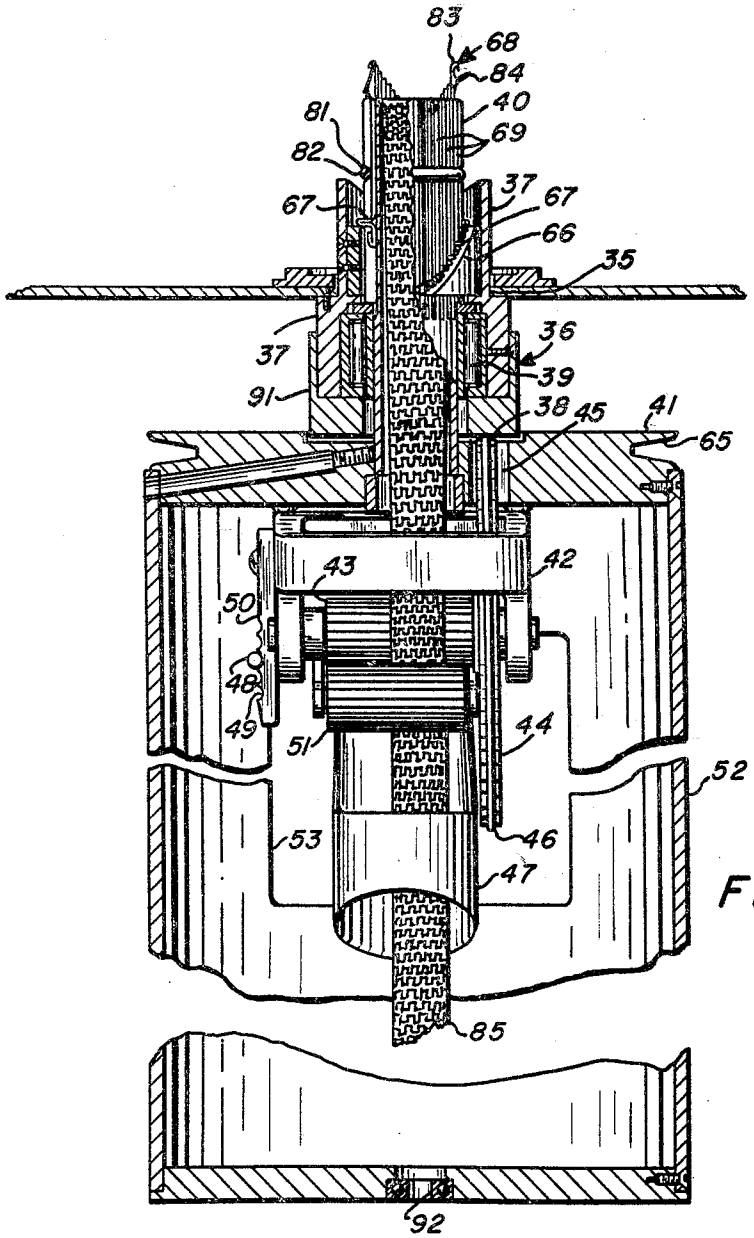


Fig-5

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CIRCULAR KNITTING MACHINE

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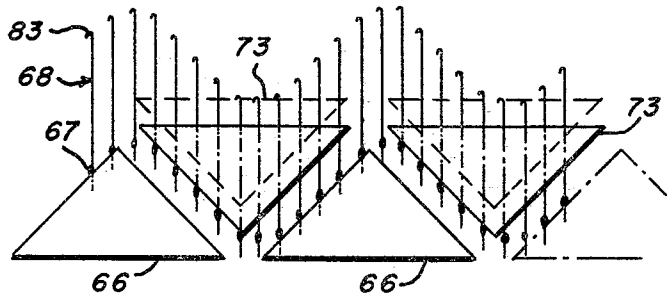


Fig-10

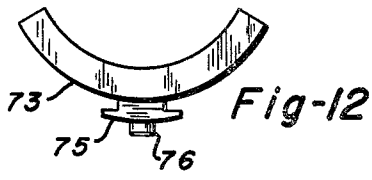


Fig-12

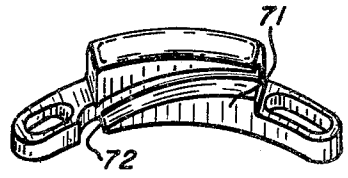


Fig-9

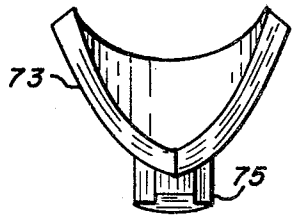


Fig-8

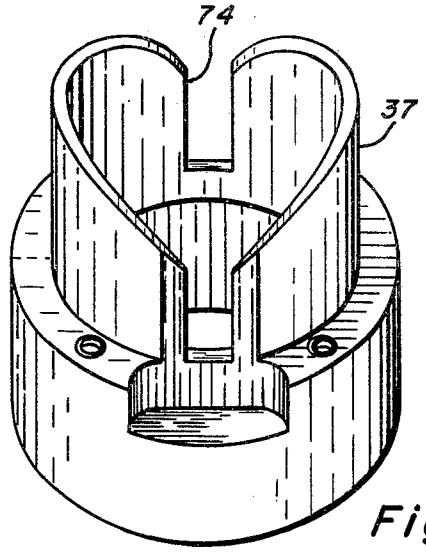


Fig-6

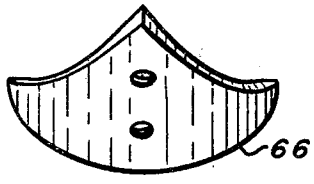


Fig-7

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3,068,674

# CIRCULAR KNITTING MACHINE

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Filed July 27, 1960, Ser. No. 45,637

2 Claims. (Cl. 66—54)

My invention relates generally to machines which knit circular or tubular items, and particularly to such machines in which the needles are carried in a needle cylinder which rotates at high speed, which needles also rise and fall in the conventional knitting action.

It is among the objects of my invention to produce a high speed circular knitting machine.

It is yet a further object of my invention to produce a knitting machine in which the needle cylinder also rotates as the needles rise and fall in knitting.

Yet a further object of my invention is to provide a knitted product receiver which will contain the knitted product from the rotating needle cylinder without the product being twisted.

A still further object of my invention is to provide a circular knitting machine which will knit with a plurality of threads, either singly, or in pairs, and of many differing colors so that a variety of color effects will be achieved as a continuous strip is knitted.

Still a further object of my invention is to achieve truly high speed circular knitting having a chosen looseness or tightness in the courses.

Another object of my invention is to provide an apparatus which will automatically and continuously produce uniform high quality circular knitted items useful as sleeves, borders, edging, collars, and for numerous other things.

These objects and advantages as well as other objects and advantages may be achieved by the apparatus illustrated in the drawings in which:

FIGURE 1 is a front elevational view of a circular knitting machine embodying my invention;

FIGURE 2 is a vertical sectional view looking in the direction of the arrows taken on the line 2—2 in FIGURE 1;

FIGURE 3 is a horizontal sectional view looking in the direction of the arrows taken on the line 3—3 in FIGURE 1;

FIGURE 4 is a partial horizontal sectional view looking in the direction of the arrows taken on the line 4—4 in FIGURE 1 showing the adjustment assembly for controlling looseness or tightness of knit;

FIGURE 5 is a partial vertical sectional view looking in the direction of the arrows taken on the line 5—5 in FIGURE 4, showing the sub-table receiver, tensioning pulling means, and rotational support for the knit item receiver;

FIGURE 6 is a perspective view of a descending-cam holder;

FIGURE 7 is a perspective view of an ascending cam;

FIGURE 8 is a front perspective view of a descending cam;

FIGURE 9 is a perspective view of a descending cam adjuster;

FIGURE 10 is a flat plan vertical elevational view of the ascending and descending cams, which are actually arranged in a circle, but are here shown in a straight line in order to explain their camming relationship to the knitting needles as the needle carrier revolves within the circle of fixed ascending and descending cams;

FIGURE 11 is a view in perspective looking upwardly toward the bottom of the thread distributor; and

FIGURE 12 is a top view of the stitch cam.

Referring generally to the figures, which illustrate an embodiment of my invention, I provide a needle cylinder for a plurality of knitting needles. The knitting needles are disposed in tracks on the carrier. The carrier revolves inside a circle of generally triangular ascending and descending cams which engage a portion of each of the needles and cause them to rise up the ascending tracks of the cams and move down the descending tracks of the cams as the needle cylinder revolves; i.e., the transition from contact with an ascending track cam to a descending track cam causes the needles to reverse and descend. Threads are fed from a carrier to the needles on the revolving carrier. As they rise and fall, their hooked ends engage the threads and knit successive courses. Multiples of cams enable the use of multiples of threads fed to the needles. The circular knit item is pulled from the needles as it is discharged off their tops and is deposited in the bottom revolving receiver. The receiver is rigidly connected to and revolves with the revolving needle cylinder in order that the knit product should not be twisted, as it would be, if deposited into a stationary receiver. The rotation of the needle holder inside stationary cams, rather than the rotation of the cams around a stationary needle holder, has been found to permit very high speed continuous operation and the automatic production of exceedingly large quantities of circular-knit items of many and varied coloration, depending upon the number of threads fed and the corresponding number of cams used.



The circular knitting machine in accordance with my invention provides a table 21, which serves as a mounting for the knitters, hereinafter referred to. At the rear of the table 21, a rack 22 extends upwardly. The rack is provided with several crossbars upon which are mounted spindles 23. The spindles are generally conical in shape and serve to mount spools 24 of thread. These spools are wound with thread, and the thread 25 is lead upwardly from each of the spools to and through an eye 26. From the eye, the thread passes through a conventional thread tension means that is adjustable to regulate the tension of the thread. From the tension means 27, the thread passes through a second eye 28 from which it moves downwardly through guides 29 to a thread distributor 30. The thread distributor (FIGURE 11) is a generally horizontal member having a U-shaped opening 31 at one end and a thread guide 32 at the other end. The thread distributor is mounted on a pedestal 33 to rigidly maintain it in position above the table 21. The threads from a selected number of spools 24 are lead through the thread guide 32 toward the U-shaped opening 31. At spaced intervals around the U-shaped opening 31, there are thread feeds 34 extending to the vicinity of the needles which will hereafter be referred to. These thread feeds 34, 34 are directed inwardly toward a common center and the threads pass through them before being engaged by the needles.

The table is provided with an aperture 35 for each of the knitting heads 36. Inserted in the aperture 35 is a tubular support 37 rigidly connected to the table 21. The tubular support 37 has an interior bearing 39 which rotatably supports a needle cylinder 40. The lower end of the needle cylinder 40 is attached to a horizontal drive wheel 41 so that the horizontal drive wheel 41 will rotate the needle cylinder 40. A drive wheel bracket 42 is pivotally attached to the bottom of the horizontal drive wheel 41. The bracket carries a rolier 43 which is supported at each end for rotation on the bracket 42. The roller 43 has a corrugated surface which may be a rubber sleeve having a high coefficient of friction. Mounted on the end of the axle of the roller 43 is a vertical drive wheel 44. The horizontal drive wheel 41 is provided with a slot 45 through which the vertical drive wheel 44 extends and engages with a track 38 on the bottom of the collar 91. The peripheral edge of the vertical drive wheel 44 is grooved and provided with a rubber

ring or insert 46. The track 38 has a ribbed surface to provide for engagement with the insert 46 and thereby to affirmatively drive the vertical drive wheel 44 as the horizontal wheel 41 rotates.

A pivoted knit-item guide 47 provided with a slot is mounted on the drive wheel bracket 42. This guide 47 has a spring arm 48 engageable with one of a plurality of grooves 49. The guide 47 is carried by a guide arm 50, which rotatably mounts a second roller 51. Adjustment of the spring arm 48 engages the rollers 43, 51 together. The roller 43 is rotated by the vertical drive wheel 44 and is in engagement with the second roller 51. Thus, as the horizontal drive wheel 41 is rotated, the rollers will engage between them knitted material produced, exert tension upon it, and cause it to be pulled downwardly under tension and deposited into a cylinder 52, which depends from the horizontal drive wheel 41. The guide wheel bracket 42 is secured against pivoting by a catch that engages it with the drive wheel 41 at the end opposite its pivotal connection.

The cylinder 52 is provided with opposite openings 53 for convenience in withdrawing the knitted product deposited in the cylinder as it rotates. The bottom of the cylinder 52 is axially supported by a pin 54 mounted on the bottom of the table 21. This pin 54 engages a bearing 92 attached to the center of the cylinder 52. On the rear vertical wall 56 under the table 21, a motor 57 is mounted. A horizontal shaft 58 is mounted for rotation across the sidewalls of the table 21. The horizontal shaft 58 carries a pulley 93 which is connected by a belt 60 to the motor pulley. The horizontal drive shaft 58 carries a pulley 59 for each of the cylinders 52. This pulley 59 is engageable and disengageable from the shaft by a clutch 61, which is operated by the lever 62, on the front of the table. The pulley 59, on the horizontal shaft 58, drives a belt 63, which passes over the idler 64 and runs in a pulley track 65 in the drive wheel 41.

It will be seen therefore that the drive wheel 41 rotates by virtue of the belt 63 and causes the needle cylinder 40 to rotate. Likewise, the vertical drive wheel 44 being moved in contact with the stationary track 38 rotates causing the puller rollers 43, 51 to rotate and pull downwardly the knitted material produced by the knitting head 36. The cylinder 52 being mounted on the horizontal drive wheel 41 rotates therewith in correspondence with the rotation of the needle cylinder 40. Thus, the product of the needle cylinder 40, as it rotates, is deposited in a correspondingly rotating cylinder 52 and is not twisted or snarled therein as it would be if deposited in a stationary cylinder.

The tubular support 37, which surrounds the needle cylinder 40 is attached to the table 21 and mounts a pair of generally triangular cams 66. These ascending cams 66 engage a horizontal projection or needle butt 67 near the lower end of each of the needles 68. Thus, as the needle cylinder 40 revolves, the needles 68, which are freely slidable upwardly and downwardly in vertical tracks 69 in the needle cylinder 40, are caused to rise and fall by virtue of the needle butts 67 (serving as cam riders) engaging the generally triangular cams 66 and riding up them as the needle cylinder 40 rotates. This will be seen in FIGURE 10, which is a view of the cams which are arranged in a circle, unfolded, and arranged in a straight line for purposes of depicting the camming of the needle enlargements. These triangular cams 66 are bolted to the inside of the tubular support 37 in opposition to each other. The cams 66 are the cams which cause the needles to rise.

Surrounding the support 37 is an annular, adjustable descending cam holder 80, with a radial flange 70. The cam holder is provided with enlargements 71 (see FIG. 9) which have ascending internal tracks 72. The enlargements are arranged diametrically opposite each other on the descending cam holder in the two-thread four cam knitting head illustrated. A descending retractor cam 73 (shown in FIG. 8) is positioned for slidable upward and downward movement in vertical slots 74 in the tubular support 37. A flanged dove-tail enlargement 75 on the back of the cam 73 serves to retain the descending cam in the slots 74. A cam rider 76 follows the track 72 on the enlargement 71.

The descending cam holder 80 functions as an adjustment ring. It is provided with a pointer 77 and a related calibrated scale 78. The peripheral edge of the holder 80 is locked in position by a thumb screw 79 at the side of the holder 80. A pair of retainers 94 are attached to the table to position the holder 80 for rotation. Thus, with the adjustment of the holder 80, the tracks or cam surfaces 72 move with respect to the pins 76 on the descending or retractor cams 73 causing the cams 73 to assume a higher or lower position (see dotted lines in FIG. 10) with respect to the ascending cams 66. In this manner, the movement of the needles 68 is adjusted to a narrower or wider range and to provide a looser or tighter knit.

The needle cylinder 40 is a generally tubular member supported for rotation in the tubular support 37. The top end of the needle cylinder 40 is provided with a plurality of vertical tracks 69. Near the top of the needle cylinder 40, there is a circumferential channel 81 that provides a seat for an O-ring 82. Since the needles 68 are positioned in the needle track 69 with the needle butts 67 below this circumferential channel 81, the O-ring engages the butts 67 to retain the needles against upward movement too far in the tracks, and holds them in assemblage as well as maintains them in their tracks against the stresses of the knitting operation in order that they may resist any tendency to move outwardly from their tracks 69. The needles 68 are of the well known standard type, provided with a hooked end 83 and a pivoted arm or latch 84, which latch in its upward position will enclose the end of the hook 83 so that a knitted course may slide off the hook. When the pivoted latch 84 is pivoted downwardly by a knitted course sliding down from the hook, the latch 84 assumes a position extending slightly outwardly from the shaft of the needle. As the needle 68 is retracted into its track 69, the knitted course slides upwardly and causes the arm 84 to pivot over and cover the hook 83 so that the knitted course may smoothly slide off the needle. By arrangement of an additional appropriate number of cams 66, 73, knitting may be carried out with several additional colored threads alternating in colored courses and providing an attractive and varied knitted product. Thus, if two threads are to be fed to the needles on the needle cylinder 40, the knitting head 36 should be provided with two ascending cams and two descending cams as shown in FIG. 10. If, on the other hand, four different colored threads are to be used, the knitting head 36 should be provided with four ascending cams 66 and four descending cams 73; and further, if the knitting head is to utilize three different colored threads, the knitting head 36 should be provided with three descending cams 73 and three ascending cams 66. It is further to be noted that instead of feeding a single thread to each of the thread feeds 34, two different colored threads may be fed to each one, thereby producing a novel, multi-color effect.

In operation, threads 25 are led through the various eyes 29 to the thread feeds 34 and engaged with the hooked portion 83 of the needles 68. The motor switch is turned on and the lever 62 is manipulated to engage the clutch 61 operably connecting the drive shaft 58 to the drive wheel 41. The needle cylinder 40 commences to rotate and the cams 66, 73 cause the needles to ride up and down in the tracks 69 engaging the thread and drawing the thread through the thread feeds 34. The successive knitted courses are slipped off of the needles and extend down through the tubular knitting head 36 until they reach the point at which they may be inserted

between the rollers **43** and **51**, after which the operation proceeds at high speed without any further attention or control. The multi-colored circular-knitted sleeve **85** is deposited in the cylinder **52** and when the cylinder is full, rotation is stopped by the lever **62** and the product extracted through the aperture **53**.

While I have described and illustrated a two-thread knitting head with two ascending and two descending cams, a pair of each type cam may be added for each additional thread to be knitted, with an incidental corresponding reduction in size of the cams to accommodate them around the needle cylinder.

The foregoing description is merely intended to illustrate an embodiment of the invention. The component parts have been shown and described. They each may have substitutes which may perform a substantially similar function; such substitutes may be known as proper substitutes for the said components and may have actually been known or invented before the present invention; these substitutes are contemplated as being within the scope of the appended claims, although they are not specifically catalogued herein.

What is claimed:

1. A circular knitting machine comprising a stationary tubular support for a needle cylinder, a needle cylinder rotatably mounted on the tubular support, a receiving-cylinder rigidly connected to the needle cylinder for rotation therewith, a bracket mounted in the receiving cylinder, a driven puller-roller mounted on the bracket, a spring-loaded puller-roller also mounted on the bracket and engaged with the driven puller-roller, a drive wheel attached to the axle of the driven puller-roller, the drive wheel extending upwardly through a slot at the top of the receiving cylinder into frictional engagement with the bottom of the stationary tubular support.



2. A circular knitting machine comprising a needle cylinder, a table rotatably supporting the needle cylinder, the needle cylinder having a plurality of peripheral longitudinal needle tracks, knitting needles slidably positioned in the tracks, means to slidably retain the needles in the tracks, a slotted horizontal drive wheel attached to the bottom of the needle cylinder, means to rotate the drive wheel, a plurality of ascending and descending stationary cams surrounding the needle cylinder and in operable engagement with the needles as the needle cylinder rotates, a rotatable knit-product receiver rigidly attached to the slotted horizontal drive wheel, a tubular slotted stationary support surrounding the needle cylinder, the descending stationary cams each having an enlargement at the back positioned in a slot in the support, a cam rider on each of the enlargements and extending through a slot in the support, an adjustable ring surrounding the tubular support, cam tracks on the adjustable ring surrounding the tubular support and engageable with the cam rider for raising and lowering the descending stationary cams, ascending cams attached inside the tubular support in cooperative spaced relation to the descending cams, puller-rollers mounted in the receiver, a vertical drive wheel connected to one of the puller-rollers and extending through the slotted horizontal drive wheel into frictional engagement with the bottom of the tubular slotted stationary support.

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