METHOD AND APPARATUS FOR KNITTING TIE-IN FLEECE FABRICS

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ABSTRACT OF THE DISCLOSURE

Knitting machine apparatus for making tie-in fleece fabric is disclosed. Each course of such fabric is produced according to the following set of operations: (1) certain selected needles are first raised, fleece yarn laid in, and the remainder lowered to a given level; (2) the needles are all further elevated to draw tie-in yarns into such fleece yarn being woven among the selected needles and the remainder thereof by sinker action; (2) all needles are lowered to the given level to knock over the fleece yarn, but such needles are not lowered to cast-off level; (3) all needles are elevated to draw base yarn, and then lowered to such given level; (4) after a dwell at such given level, the needles are all lowered to cast-off level.

This invention relates to a novel and improved method and knitting apparatus of the type adapted to incorporate a plurality of yarns in each course of knitting for the production of tie-in fleece fabrics. More particularly, this invention relates to equipment for knitting tie-in fleece fabrics similar to that described in the United States Patent No. 2,094,180 in which a fabric knit of base yarn has fleece yarns secured on one surface of the fabric by intermediate or tie-in yarns which are concatenated with the fleece yarns and with selected stitches of the base yarns.

It is an object of this invention to provide a novel and improved system for knitting tie-in fleece fabric on a circular knitting machine with a material increase in productivity and without sacrifice of any aspect of versatility of the knitting machine.

Among the more basic aspects which must be observed in order to preserve versatility in a circular knitting machine is the selection of a needle bed of standard diameter so that replacement parts may be readily obtainable. Another aspect basic to versatility is that the machine must be constructed so as to accept operating means for the knitting elements in units, or section blocks, which are uniform in dimension about the machine so that exchange or regrouping these units or section blocks is uninhibited.

In the production of tie-in fleece fabric since a plurality of yarns must be incorporated into the fabric in each knitted course, a number of successive section blocks, i.e., units of operating means, are required to produce each course of the fabric. The group of section blocks required to form each knitted course in the fabric may be referred to as a "set." Successful conventional tie-in fleece machines commercially available at present utilize a "set" which occupies the space equivalent to that occupied by four section blocks, since four distinct operational sequences of the knitting elements are required to complete each course of knitting. Since the smallest practical size for each unit of operating means for the knitting elements, commensurate with individual needle selection as is required with tie-in fleece knitting, occupies approximately 1 3/4 inches about the periphery of the machine, forty-eight section blocks can be accommodated on a 26 inch diameter tie-in fleece knitting machine, and therefore, twelve sets are provided in the presently available commercial tie-in fleece machine. The productivity of this machine is thus twelve courses per revolution.

It is pointed out that the twelve sets available in conventional tie-in fleece machines are evenly divisible by 2, 3, or 4 and, therefore, this machine is ideally versatile since any of the standard patterns of tie-in stitches may be produced whether repeating on every other course, every third course, or every fourth course. In order to increase the productivity of a tie-in fleece knitting machine without sacrifice of versatility, the number of sets accommodated about the machine must be increased to the next number above twelve which is divisible by 2, 3, and 4, i.e., the sets must be increased to twenty-four. Anything short of this increase will provide a machine in which the increase in productivity is attained at the expense of versatility.

The obvious expedient of so increasing the diameter of the machine that twenty-four conventional sets might be accommodated would also result in attainment of increased productivity at the expense of versatility since the resulting machine size would be unique in that it is not compatible with any standard knitting machine parts.

The present invention provides for a novel sequence and mode of operation of the knitting instrumentalities to produce tie-in fleece fabric utilizing for the production of each knitted course a "set" which occupies the space equivalent to that occupied by only two section blocks. Therefore, in a standard size circular knitting machine which can accept forty-eight section blocks, twenty-four sets may be accommodated for the production of tie-in fleece fabric.

With the above and additional objects and advantages in view as will hereinafter appear, this invention comprises the devices, combinations, and arrangements of parts hereinafter described and illustrated in the accompanying drawings of a preferred embodiment in which:

FIG. 1 is a semidiagrammatic development of a portion of an open top circular knitting machine illustrating in top plan view the sinker motion which occurs relatively to one "set" of section blocks in an arrangement embodying this invention,

FIG. 2 is a semidiagrammatic development of that portion of the knitting machine shown in FIG. 1 illustrating in elevation the needle motion and the needle influencing means of this invention,

FIG. 3 is a vertical cross sectional view taken through the knitting machine substantially along line 3—3 of FIG. 2,

FIG. 4 is a plan view of a portion of fabric which will be produced by the arrangement illustrated in FIGS. 1, 2, and 3 viewed from that side of the fabric on which the fleece yarns are exposed,

FIG. 5 is a cross sectional view of the fabric of FIG. 4 taken substantially along line 5—5,

FIG. 6 is a diagrammatic representation of the knitted tie-in and base yarn loops of the fabric illustrated in FIG. 3, with those loops beneath which the fleece yarn is anchored by the tie-in yarn being indicated by an "x,"

FIGS. 7 and 8 are diagrammatic representations similar to FIG. 5 but showing different patterns of loops beneath which the fleece yarn is anchored by the tie-in yarn, and

FIG. 9 is a top plan view of a portion of the needle cylinder of a circular knitting machine embodying this invention and illustrating the arrangement of section block sets thereon.

FIGS. 4 and 5 illustrate a conventional tie-in fleece fabric which may be produced utilizing this invention and which comprises successive knitted courses of base yarns 10 and plaited tie-in yarns 20, with a fleece yarn 30 being anchored in each course by selected ones of the stitches of the tie-in yarn 20. In FIG. 4, the successive courses are indicated at A, B, and C while the rows of stitches are indicated at 40, 41, 42, 43, and 44. In al-
ternate rows, A, C, etc., the fleece yarns 30 are anchored by tie-in yarn loops at stitch rows 40, 44, etc., while in every other course, B, etc., the fleece yarns 30 are anchored by tie-in yarn loops at stitch row 42. As illustrated in FIG. 5, the fleece yarns 30 will be visible on only one side of the fabric, the opposite side showing only the base yarn 10 and having the appearance of a plain jersey knit.

FIG. 6 represents the stitches of the fabric shown in FIG. 5 in a diagrammatic form with the courses being similarly indicated at A, B, and C and the stitches similarly indicated at 40 to 44. In FIG. 6 the stitches appearing as an ‘x’ illustrate those at which the tie-in yarn 20 anchors the fleece yarn 30 to the base yarn, and FIG. 6 better illustrates the alternating pattern of such anchor points for the fleece yarn. Since alternate courses differ in the fabric represented in FIGS. 4 and 6, the control instrumentalities regulating the concatenations of yarns for each course must be arranged in pairs about a circular knitting machine in order to produce such a fabric and furthermore, the total number of such anchor points about the knitting machine must be evenly divisible by two.

FIG. 7 represents a pattern of anchor points for tie-in fleece yarns which repeats every third course and thus requires control instrumentalities in groups of three with the total number evenly divisible by three. FIG. 8 similarly represents a pattern requiring control instrumentalities in groups of four with the total number evenly divisible by four.

Referring to FIGS. 1, 2, and 3, an arrangement of knitting elements and control instrumentalities therefor will now be described whereby, on a given knitting machine, any of the patterns of tie-in fleece fabric shown in FIGS. 6, 7, and 8 may be produced at twice the rate heretofore attainable.

Indicated at 50 in FIG. 3 is a conventional needle cylinder which is formed with vertical slots 51 at regular intervals slidable to accommodate a bank of latch knitting needles 52. Each knitting needle is formed with a yarn engaging hook 53, a pivot latch blade 54, and a shank 55 formed at the extremity opposite to the hook with a butt 56 which protrudes from the cylinder slot 51 and by which the vertical position of the needle in the cylinder may be controlled.

The top of the needle cylinder may be formed with radial slots 60 between each of the needle slots 51 to provide rest or guide surfaces for a bank of needles radially arranged, one between each of the needles 52, or as shown in the drawings the sinker slots 60 may be formed in a sinker rest ring secured to the top of the cylinder. Each sinker is formed with a lower blade 62, a smaller upper blade 63, and a yet smaller nose 64 above the upper blade 63. The juncture of the upper and lower blades defines a lower throat 65, while the juncture of the nose 64 with the upper blade defines an upper throat 66. The upper and lower blades 63 and 62 outwardly of the throats provide two different levels for support of the concatenated yarns between adjacent needles. Each sinker, moreover, is formed with a shank 67 having an upwardly projecting blade 68 by which the radial position of the sinker may be controlled.

Indicated at 70 in FIGS. 1 and 3 is a support ring for sinker operating cams 71 which straddle the sinker buttocks 68 to control the radial sinker movements in the path indicated by the phantom lines in FIG. 1. Indicated at 72 in FIGS. 2, 3, and 9 is a support member upon which section blocks 74 and 75 are secured alternating in pairs about the needle cylinder. The section blocks, as will be described hereinafter, carry the control instrumentalities by which the vertical movements of the needles are dictated. The sinker cam support ring 70 and the support member 72 may be secured together as a unit in a manner conventional in the art. The needle cylinder 50 together with the needles and sinkers in the slots therein is rotatable relatively to the unified supports 70 and 72 and while the description hereinafter will treat the needle cylinder as rotating relatively to the supports in the direction of arrowheads 1, 2, and 8, it will be understood that this invention is equally applicable to the alternative arrangement in which the needle cylinder remains stationary.

Journalized on the section block 74 on an axis inclined relatively to the needles 52 is a pattern wheel 80 which may be of any conventional type such as that described in the United States Patent No. 2,055,598 to which reference may be had. The pattern wheel is formed with inclined peripheral slots 81 adapted to mesh with the needle butts 56. The pattern wheel slots may either be left empty or filled with jacks 82 which selectively elevate those needles meshing with the jack filled slots. In FIGS. 1, 2, and 3 every fourth slot of the pattern wheel is occupied by a jack and therefore every fourth one of the needles as indicated at 52 will be raised by the pattern wheel. Those adjacent to the pattern wheel 80 on the section block 74 is a needle raise cam 83 which is positioned so as to engage and elevate all of the needle butts 56 but at a position slightly beyond that at which the pattern wheel has influence.

The needles approaching the pattern wheel 80 and the needle raise cam 83 will, of course, have upon their shanks the loops of base yarn 10 and tie-in yarn 20 which were concatenated on formation of the previous course of knitting. These previous loops of yarn will be constrained beneath the upper blades 63 of the sinkers so as not to move upwardly, and the needles will be elevated upwardly through these previous yarn loops.

A yarn carrier 84 for the fleece yarn 30 is sustained relatively to the supports 70 and 72 in a position as illustrated in FIG. 2 to deliver fleece yarn 30 to the hooks of those needles 52 which have been elevated by the pattern wheel 80 at the level of the upper sinker throat 65. Prior to the influence of the needle raise cam 83, as illustrated in FIG. 1, the sinkers 61 are shifted inwardly by the sinker cams 71 to carry the fleece yarn in the upper sinker throats 66 inwardly beyond those needles which are not elevated by the pattern wheel. At the instant the needle raise cam 83 is elevated all of the needles to latch cleard position, therefore, the fleece yarn 30 will extend or float behind all the needles 52 and be concatenated about every fourth needle 52.

The section block 74 also carries a stitch or draw cam 85 which acts on the butts of all of the needles to effect a partial draw of each needle downwardly to a position as illustrated in FIG. 2 in which the hooks 53 pass below the level of the upper sinker throats 66 but not below the level of the lower throats 65. A yarn carrier 86 is sustained relatively to the supports 70 and 72 so as to deliver a tie-in yarn 20 to the hooks of all of the needles 52 and 52 as the needles are being influenced by the stitch cam 85. Since the fleece yarn 30 is retained in the upper sinker throat 66, when the needle hooks 56 are drawn beneath this level, the fleece yarn will be knocked over the hooks of the needles 52. Each of the needles 52 and 52 moreover, will either measure or measure out loops of the tie-in yarns 20 over the upper blades 63 of the sinkers. This measuring of tie-in yarn loops is preferably adjusted to correspond to the precise amount which will be required later in the knitting process when the tie-in yarn loops will be knitted together with base yarn loops. At the instant the sinker will be retracted slightly by the sinker cams 71 opposite the point of maximum draw of the needles provided by the stitch cam 85 so as to present the tie-in yarns to the upper blades 63 of the sinkers. The draw of the needles effected by the stitch cam 85 is not sufficient however to cause knitting of the tie-in yarn loops since the needle hooks are not drawn beneath the level of the lower sinker throats at which level the previous base and tie-in yarn loops on the needle shanks are supported.

At this point in the knitting process, the needle influenc-
ing cams carried by the second section block 75 become effective. The section block 75 carries a needle raise cam 90 which raises all of the needles 52 and 52' to a level at which the latch blades do not clearance the tie-in yarn loops. The sinkers 61 are shifted radially inward so that the upper throats 66 will disintend and control the previously measured tie-in yarn loops on the needles.

A stepped stitch cam 91 is carried by the section block 75 so as to engage and influence the butt of all of the needles 53 and 53' after they pass from the raise cam 90. A yarn carrier 92 is suggested relatively to the supports 70 and 72 so as to deliver a base yarn 10 from above the level of said upper blades 63 to the hooks of all of the needles 52 and 52' as the needles are influenced by the stitch cam 91. Thus it is seen that the tie-in yarn serves to open the throats of all of the needles at the section 75 as such needle are raised to take the base yarn 10.

The stitch cam 91 is formed with a first needle drawing cam surface 93, a dwell portion 94, and a second needle drawing cam portion 95. The first needle drawing cam surface 93 carries all of the needles downwardly to a position illustrated in FIG. 2 which position is at substantially the same level as the level to which the first cam of the first set draws the needles, in which position the hooks 53 are beneath the level of the upper sinker throats 66 but above the level of the lower sinker throats 65. As illustrated in FIG. 1, the sinkers 61 at this point are retracted slightly by the sinker cams 71 so as to support the newly inserted base yarn upon the upper blades 63 between each of the needles, whereby the base yarn loops and the tie-in yarn loops will be provided with substantially the same lengths. In other words the base yarn is measured into loops on each of the needles of a size equal to that which will be required when these base yarn loops are knitted together with the previously measured tie-in yarn loops. The dwell portion 94 of the stitch cam 91 is preferably of that length which will permit this measuring of the base yarn loops to be completed before the needles reach the second needle drawing cam portion 95. A dwell portion 94 of sufficient length to accommodate three of the needles 52 or 52' has been found to be sufficient.

The second needle drawing cam portion 95 of the stitch cam 91 then acts upon the butts of all of the needles to draw the needles below the level of the lower sinker throats 65. Opposite the second needle drawing cam portion 95, as illustrated in FIG. 1, the sinkers 61 will be retracted by the sinker cams 71 so as to release the tie-in and base yarn loops from the upper blades 63 to the lower blades 62 of the sinker. As the needles pass below the level of the lower sinker throats 65, the previously held base and tie-in yarn loops will be knitted therewith. The draw of the second needle drawing cam portion 95 is preferably set to at amount which will draw down precisely those loops of base and tie-in yarns which were previously measured as explained above.

Repeating to FIG. 9, successive "sets" of section blocks 74 and 75 are indicated by the Roman numerals I to VII. In order to produce a fabric such as is illustrated in FIGS. 4 and 6 in which the fleece yarns are anchored at different stitches in every other course, the sets of section blocks about the knitting machine must be arranged in pairs. Sets I, III, V, etc., will produce similar courses of knitting, and sets II, IV, VI, and VIII will produce the alternate courses. If a fabric pattern as illustrated in FIG. 7 is desired in which the pattern repeats in every third course, then the sets of section blocks must be arranged in groups of three about the machine, for instance in FIG. 9 with sets I, IV, VII, etc., producing similar courses of knitting. It will be appreciated that since the method provided by this invention makes it possible to arrange all the actuating instrumentals for the knitting elements necessary to produce each course in only two section blocks of substantially conventional sizes so that twenty-four conventional sets of section blocks can be accommodated about the knitting machine, patterns of fleece yarns anchoring stitches repeating in either two, three, or four courses may be readily produced.

The salient aspects of the method of knitting tie-in fleece fabric of this invention which permits the actuating instrumentals to be accommodated in two equal size section blocks are that the three yarns 20, 26, and 30 of the tie-in fleece fabric are incorporated into the fabric while the needles are operated in only two successive raises and draws, one raise and one draw of the needles being accomplished by instrumentals on each of the section blocks. This compact arrangement and the compact arrangement is made possible by the present method of utilizing needles about which the fleece yarns are directed. The method of selecting those needles which are destined to carry the fleece yarn slightly in advance of the raise of all the remaining needles by the raise cam 83, which obviates the need for an additional draw of the needles as was required in the prior art, makes possible the compact arrangement of the section block 74.

The method of measuring first the tie-in yarn loops by the partial draw of the needles effected by the draw cam 85 and then measuring of the base yarns by the partial draw of the needles effected by the cam surface 93 and dwell portion 94 of the stitch cam 91 provides for a novel smoothness of formation of tie-in fleece fabric utilizing a compact second section block arrangement 75.

Having thus set forth the nature of this invention, what is claimed herein is:

1. A sinker top circular knitting machine, a bank of latch knitting needles, and a bank of sinkers alternating between adjacent needles of said banks of needles and actuating means for said said sinkers and sinkers for producing tie-in fleece fabric comprising a first and a second set of raise and draw cams arranged in sets and in effective to influence all of the needles in said bank, a needle selecting means effective to raise selected ones of said needles prior to engagement of the raise cam of said first set of cams, a fleece yarn carrier for introducing fleece yarn to needles raised by said needle selecting means, sinker actuating means for sinking said fleece yarn rearwardly between said selected needles, a tie-in yarn carrier for feeding tie-in yarn to all of said needles during influence of said draw cam of said first set of raise and draw cams, said draw cam of said first set being adapted to lower all of said needles to a given level below the level at which said tie-in yarn is fed to said needles but above the cast-off level of said needles, and a base yarn feeding a base yarn to all of said needles during influence of said draw cam of said second set of raise and draw cams, said sinker top circular knitting machine being the type in which said sinkers are each formed with an upper and a lower blade, said base yarn being fed from above the level of said upper blades, in which said sinker actuating means is effective to station said upper blades in position to support yarns introduced by said fleece yarn carrier and said tie-in yarn carrier during the period of effectiveness of said first and said second raise and said first draw cam, in which said first raise cam clears the latches of all of said needles from yarn introduced by said fleece yarn carrier, and in which said first draw cam draws said needles to a position intermediate said upper and lower sinker blades, and said sinker top circular knitting machine being further of the type in which the draw cam of said second set of raise and draw and draw cam is formed with a first needle drawing cam surface positioned to draw said needles to a position intermediate said upper and lower sinker blades, which position is at substantially the same level as said given level to which said draw cam of said first set draws said needles, in which said sinker actuating means stations the upper blades of said sinkers in position to support yarns introduced by said base yarn carrier during the period of effectiveness of said first needle drawing cam surface, in which said draw cam of said second set of raise and draw and draw cam is formed with a
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dwell section, said dwell section being adapted to keep said needles at said given level for a predetermined duration, and with a second needle drawing cam surface positioned to draw said needles to a position below said lower sinker blades, and in which said sinker actuating means stations the lower blades of said sinkers in position to support yarns on said needles during the period of effectiveness of said second needle drawing surface.

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