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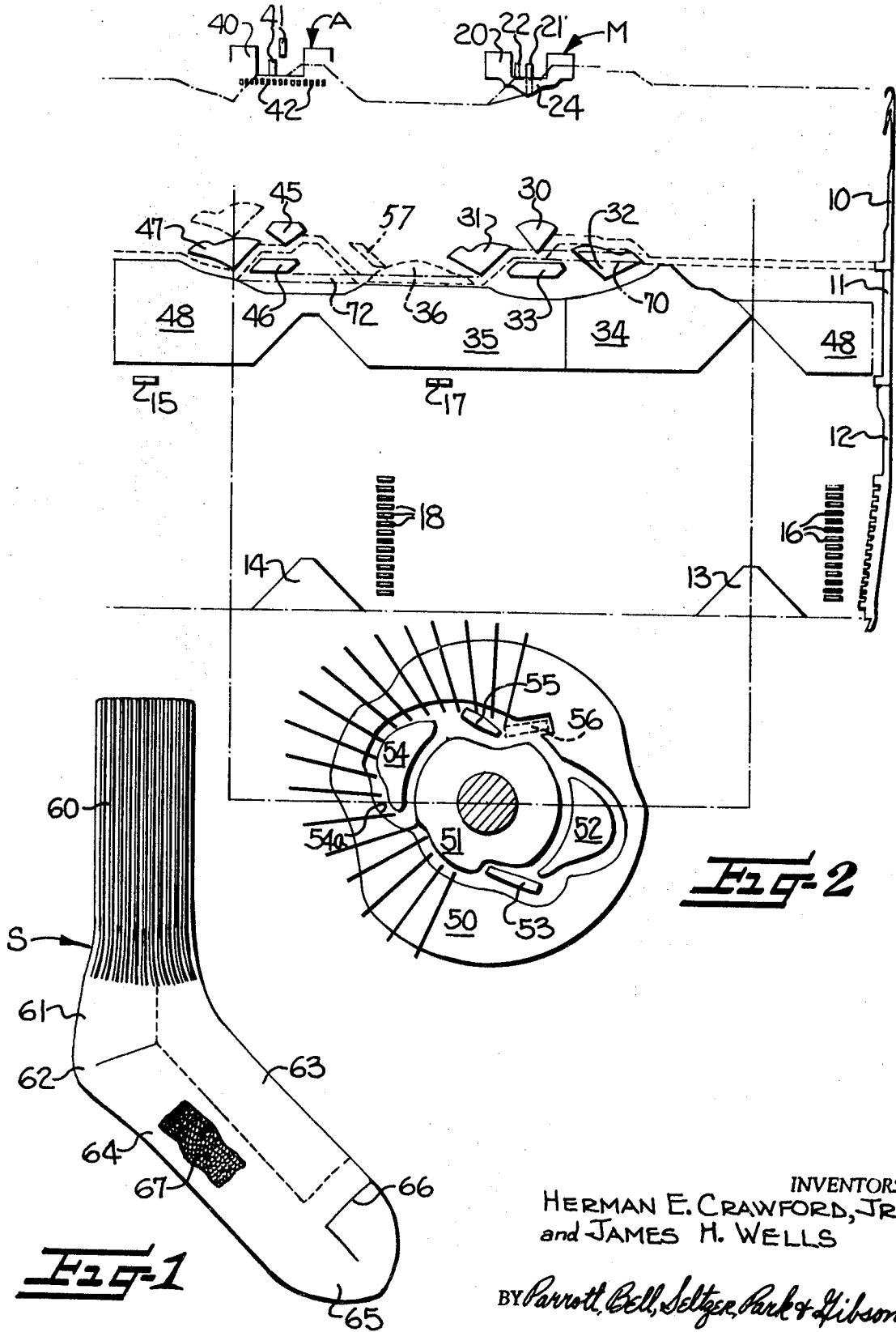
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RIB AND TERRY KNITTING MACHINE AND METHOD

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2 Sheets-Sheet 1



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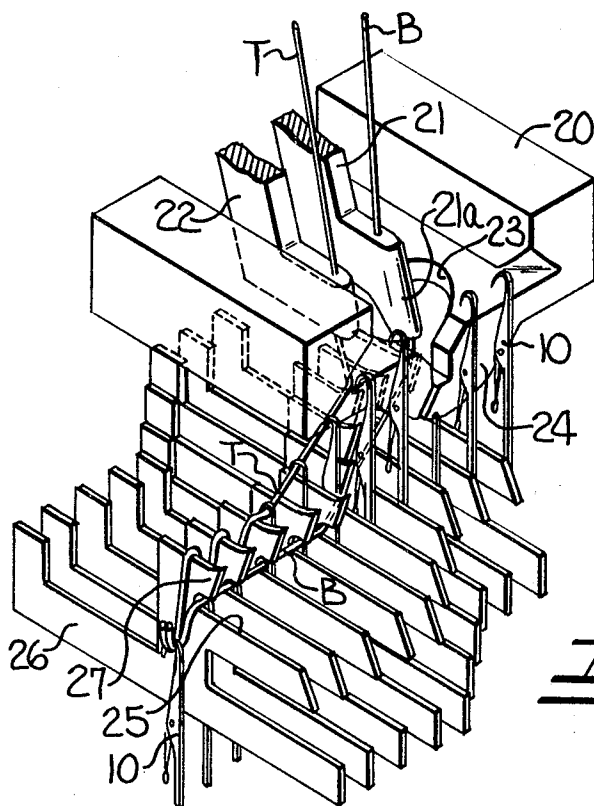


Fig-3

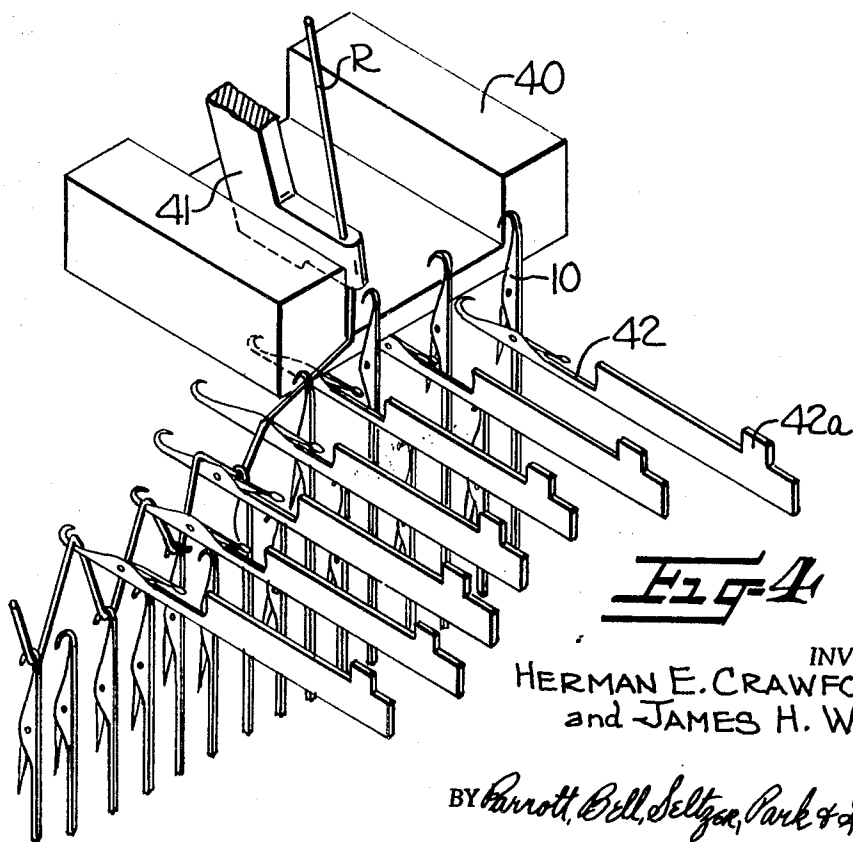


Fig-4

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RIB AND TERRY KNITTING MACHINE AND METHOD

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9 Claims

ABSTRACT OF THE DISCLOSURE

A multiple feed circular hosiery knitting machine is provided with means for forming terry loops at one knitting station and for forming a rib fabric at a subsequent knitting station. This invention is particularly adapted for use in forming socks wherein the upper cuff portion is knit of ribbed fabric while the sole portion is provided with terry loops. The present method permits the selected knitting of a ribbed fabric or a terry loop fabric in a single feed manner, as well as multiple feed plain or patterned knitting.

This invention relates generally to the knitting of a seamless fabric which is provided with areas of rib knitting and areas of terry loop knitting, and more particularly, to a multiple feed knitting machine and method for selectively knitting rib fabric and terry loop fabric in different portions of a sock.

Ribbed fabrics are usually knit on machines having axially aligned needle cylinders with hooks on each end of the needles, or on machines having a set of cylinder needles and a set of dial needles. In machines of the latter type, it is the usual practice to selectively knit either ribbed or plain fabric at the same knitting station and to form a ribbed section, such as the cuff of a sock, by knitting inwardly facing stitch loops in certain wales on dial needles while knitting outwardly facing stitch loops in other wales on cylinder needles. A plain fabric may then be knit in the remaining part of the sock by knitting on the cylinder needles only.

In order to knit a satisfactory terry loop fabric, the body yarn should be fed at a relatively low position so that it is drawn down over the stitch drawing ledges and beneath the nibs of the sinkers while the terry yarn is fed at a relatively high elevation so that it is drawn down over the tops of the nibs of the sinkers. This feeding process requires the use of a "drop" throat plate which includes a portion extending below the level of the dial needles and to a point closely adjacent the level of the stitch drawing ledges of the sinkers. This downwardly extending portion prevents the dial needles from being projected outwardly below the throat plate in the usual manner during the knitting of ribbed fabric.

With the foregoing in mind, it is an object of the present invention to provide a knitting machine and method for selectively knitting ribbed or terry loop fabric which includes one knitting station having means for knitting terry loop fabric and another knitting station having means for knitting ribbed fabric.

By providing separate knitting stations for forming sections of terry loop fabric and ribbed fabric, it is possible to utilize a "drop" throat plate at the knitting station where the terry loop fabric sections are knit and a conventional throat plate at the knitting station where the ribbed fabric sections are knit. This arrangement also permits the multifeed knitting of fabric on the cylinder needles at both stations.

It is a further object of the present invention to provide needle selection means in advance of each of the

knitting stations so that various tuck, float and plain stitch patterns may be selectively knit at both knitting stations.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevation of a sock in which the upper cuff portion is ribbed fabric and the foot is provided with portions of terry loop fabric, as illustrated in the broken-away portion thereof;

FIG. 2 is a somewhat schematic developed view of the cams surrounding the needle cylinder and a plan view of the dial cams, illustrating the manner in which the dial needle cams and cylinder needle cams cooperate when forming terry loop fabric at one knitting station and ribbed fabric at the other knitting station;

FIG. 3 is an isometric view illustrating the feeding and knitting of the body and terry yarns at the main knitting station, when a terry loop fabric is being formed; and

FIG. 4 is an isometric view illustrating the feeding and knitting of the yarn at the auxiliary knitting station, when a ribbed fabric is being formed.

Generally, the method of the present invention is carried out on a circular knitting machine having a first or main knitting station, broadly indicated at M in FIG. 2, and a second or auxiliary knitting station, broadly indicated at A. The main knitting station M is also referred to as a terry loop fabric knitting station and the auxiliary knitting station A is also referred to as a ribbed fabric knitting station.

The machine is provided with the usual needle cylinder, not shown, in which needles 10 are supported for vertical sliding movement and auxiliary jacks 11 and pattern jacks 12 (FIG. 2) are positioned therebeneath. Pattern jack raising cams 13, 14 are provided in advance of the respective knitting stations M and A. Conventional selector jack pushout cam 15 and selector levers 16 are provided in advance of the jack raising cam 13 and a jack pushout cam 17 and selector levers 18 are provided in advance of the jack raising cam 14.

At the main or terry knitting station M, a "drop" throat plate 20 is provided (FIGS. 2 and 3) in the latch ring, not shown. Yarn feed fingers 21 and 22 are supported in a conventional manner for movement into and out of yarn feeding position in the throat plate. A body yarn B is fed through the finger 21 and a terry yarn T is fed through the finger 22. The terry yarn T is fed at a relatively high elevation at it leaves the finger 22 and is drawn out the corner of the throat plate at the regular yarn feeding level. The body yarn feed finger 21 is provided with a downwardly projecting guide portion 21a (FIG. 3) which extends downwardly through an opening 23 in the throat plate 20 so that the body yarn B is fed at a level which is below the regular yarn feeding level, thereby providing a substantial difference between the feeding levels of the yarns T and B.

The inner edge of the throat plate 20 is provided with a downwardly extending projection 24 which serves as a latch guard for the needles 10. The projection 24 extends downwardly to a position closely above the normal stitch drawing ledge 25 of each sinker 26. The sinkers 26 illustrated in FIGS. 3 and 4 are of the terry loop type and each sinker includes a nib 27 having a flat upper terry loop stitch drawing ledge thereon. Conventional cams are provided in the sinker head, not shown, to control radial movements of the sinkers 26.

The usual cylinder needle stitch cams are provided at the main knitting station M and include a top center cam 30, a left-hand or forward stitch cam 31, a right-hand or reverse stitch cam 32, and a lower center cam 33. The stitch cam 32 is supported for radial movement into and out of operative position adjacent the needle cylinder.

A fixed end cam 34 is supported adjacent the stitch cam 32, a fill-in cam 35 and a radially moveable end cam 36 are supported adjacent the stitch cam 31.

A conventional type throat plate 40 is provided at the auxiliary knitting station A and yarn feed fingers 41, only one of which is shown in FIG. 4, are supported for movement into and out of operative position to feed yarn, such as a rib yarn R to the needles. The lower edge of the throat plate 40 is of a sufficient height that dial needles 42 (FIG. 4) may be projected outwardly therebeneath without any interference from the throat plate 40 and in a manner to be presently described. As is evident in FIG. 2, the projection 24 on the drop throat plate 20 extends down below the level of operation of the dial needles 42 so that it would interfere with the normal operation of the dial needles at the main knitting station.

The cylinder needle cams at the auxiliary knitting station A include a top center cam 45, a center cam 46, and a stitch cam 47 which is supported for vertical movement between the solid line active position and the dotted line inactive position shown in FIG. 2. A fixed end cam 48 is supported adjacent the stitch cam 47.

A dial cap, not shown, is supported in the usual manner adjacent the upper end of the needle cylinder and supports dial needle operating cams (FIG. 2) including an outer ring cam 50 and an inner ring cam 51. The dial needles 42 are provided with upstanding operating butts 42a and are supported for radial movement in the radial grooves of the dial bed, not shown, which is rotated in the usual manner so that the dial needles 42 rotate with the cylinder needles 10.

The dial needles in one-half of the dial are provided with long operating butts and the dial needles in the other half of the dial are provided with short operating butts, for purposes to be presently described. A transfer cam 52 is fixed to the dial cap and positioned between the outer and inner dial cams 50, 51 and a vertically moveable transfer control cam 53 is supported in advance of the transfer cam 52 to at times move the dial needles 42 outwardly as their butts are directed around the transfer cam 52, in a manner to be presently described.

Dial needle stitch cam means is provided at the auxiliary station A and includes a knitting cam 54 which is fixed on the dial cap and positioned between the outer and inner dial cam rings 50, 51 (FIG. 2) and dial needle stitch control cams 55, 56 are provided in advance of the dial knitting cam 54 and supported for vertical movement to control the operation of the dial needles 42 in a manner to be presently described. The portion of the inner surface of the cam ring 50 adjacent the dial knitting cam 54 forms a stitch drawing surface 54a.

A needle raising cam 57 is supported in advance of the auxiliary knitting station A and for radial movement between operative and inoperative positions. This cam 57 cooperates with the moveable end cam 36 in a manner to be presently described, during multifeed knitting.

METHOD OF OPERATION

The method of operation will be described in connection with the knitting of a sock of the type illustrated at S in FIG. 1. However, it is to be understood that the present knitting machine may be utilized to knit other types of hosiery articles and the like. The sock S includes a ribbed cuff portion 60, ring courses 61, a heel pocket 62, a rotary knit foot portion including an instep portion 63 extending across the top of the foot and a sole portion 64 extending beneath the lower portion of the sock. The lower portion of the sock S includes a reciprocating knit toe pocket 65 which is closed along a line 66. Terry loops, indicated at 67, are formed on the inner surface of the rear portion of the ring courses 61, in the heel pocket 62, in the sole portion 64, in the toe pocket 65, and in a few courses at the lower end of the instep portions 63.

In knitting the sock S, the ribbed cuff portion 60 is knit in a single feed manner and on alternate cylinder needles 10 and all dial needles 42 at the auxiliary or ribbed fabric knitting station A while no knitting takes place at the main or terry loop fabric knitting station M. At the main knitting station M, the yarn feed fingers 21 and 22 are raised out of active position at the drop throat plate 20, stitch cam 32 is moved outwardly to an inactive position, and the end cam 36 is moved outwardly to an inactive position. Thus, the butts of all the cylinder needles 10 move along the level path indicated in dash-dot lines at 70 in FIG. 2 so that the cylinder needles do not pick up yarn and knit.

At the top of the sock, the usual make-up is formed at the auxiliary station A by raising alternate cylinder needles 10 to pick up an elastic yarn for several rotations of the needle cylinder. The alternate cylinder needles are raised by means of the jacks 12 and raise cam 14 and the other cylinder needles remain at a low inactive level, their butts passing along the dash-dot line 72. The feed finger 41 is lowered to active position to feed the yarn R and the dial needle control cam 55 is lowered to engage the first of the long butt dial needles 42 and move them outwardly so that the butts engage the stitch cam 54 and the hooks of the dial needles 42 are moved out beneath the throat plate 40 at the auxiliary station A, as shown in FIG. 4. The yarn R is thus fed to the hooks of alternate cylinder needles 10 and to the hooks of all dial needles 42 and the alternate cylinder needles 10 are lowered by stitch cam 47 to form wales of outwardly facing stitch loops while the dial needles 42 are drawn inwardly by the stitch drawing portion 54a of ring cam 50 to form wales of inwardly facing stitch loops. The ribbed cuff section 60 is illustrated and described as being of 1 x 1 ribbed stitch construction so that alternating wales of stitch loops face inwardly and outwardly. However, it is to be understood that other types of ribbed fabric may be knit, if desired. This single feed knitting of ribbed fabric continues at the auxiliary station A to the bottom of the rib cuff section 60 and no knitting takes place at the main station M. The yarn feed fingers 41 may be changed to feed different colors or types of yarn and to form stripes or other suitable patterns in the ribbed cuff section, if desired.

At the bottom of the ribbed cuff section 60, the dial needles 42 stop knitting as the dial needle control cam 56 is lowered to direct the butts inside of the stitch cam 54. The dial needles 42 are projected outwardly above the jack cam 13 as the dial needle control cam 53 is lowered to cause the butts of the dial needles to move outwardly around the transfer cam 52 and the inactive cylinder needle 10 are raised by the pattern jacks 12 and the jack raising cam 13 so that the hooks of these inactive needles pass upwardly through the stitch loops which are held on the dial needles. As the dial needles are then withdrawn, the stitch loops are transferred to the cylinder needles, in the well-known manner. Upon the completion of the transfer course, it is preferred that about four plain courses be knit on all of the cylinder needles at the auxiliary station and this is accomplished by moving the end cam 36 and the needle raise cam 57 inwardly to operative position so that all of the cylinder needles 10 are raised to pick up and knit the rib yarn R.

To knit the ring courses 61 with terry loops in the rear portions, the body yarn finger 21 and the terry yarn finger 22 are lowered to active positions and the right-hand stitch cam 32 is moved inwardly to the operative position. The stitch cam 47, at the auxiliary station A, is raised to the dotted line inactive position and the dial needles 42 remain in an innermost inactive position. As the portions of the terry loop courses which extend around the rear portion of the sock are being knit, the corresponding sinkers 26 are moved inwardly at an earlier than normal position so that the nibs 27 move inwardly beneath the terry yarn T and above the body yarn B, as

illustrated in FIG. 3. The cylinder needles then draw an elongated sinker loop of the terry yarn T over the nibs 27 and draw regular length sinker loops of the body yarn B over the regular stitch forming ledges 25, as illustrated in FIG. 3. During the knitting of the portions of the terry loop courses which extend around the front portion of the sock, the inward movement of the corresponding sinkers 26 is delayed so that the nibs 27 of the sinkers move in above both yarns T and B to form regular sinker loops of both yarns.

Upon completion of the knitting of the desired number of ring courses 61, the needle cylinder begins to reciprocate to knit a heel pocket 62 at the main knitting station M while the instep needles are raised to an idle level in the conventional manner and hold their stitches while the heel pocket 62 is knit. The terry loops are formed in the partial courses of heel pocket 62 with each forward and reverse stroke of the needle cylinder and the butts of the cylinder needles 10 are alternately lowered by the stitch cams 31, 32. As the needle cylinder swings in reverse directions, the usual narrowing and widening operations take place in a well-known manner. During this reciprocatory knitting, the sinkers 26 move in early in both directions so that the terry yarn T is drawn down over the nibs of the sinkers while the body yarn B is fed beneath the nibs.

The terry loops are formed in the sole portion 64 and plain loops in the instep 63 in the same manner as described for the ring courses 61. Just prior to beginning the knitting of the toe pocket 65, terry loops may be formed in both the instep and sole portions 63, 64 by moving all of sinkers 26 inwardly at an earlier than normal point, as shown in FIG 3, so that the terry loop yarn T is fed over the nibs of the sinkers and the body yarn B is fed beneath the nibs of the sinkers. The terry loops are formed in the toe pocket 65 in the same manner as that described in connection with the knitting of the heel pocket 62. Upon completion of the reciprocatorily knit toe pocket 65, the usual loopers rounds are knit by continuous rotation of the needle cylinder, and these are removed during the looping or sewing operation to close the toe of the sock, along the line 66.

Thus, the ribbed cuff portion 60 of the sock S is knit in a single feed manner and at the auxiliary knitting station A so that the dial needles 42 may be projected outwardly beneath the regular throat plate 40 without any interference thereby. The terry loop fabric portions of the sock are also knit in a single feed manner, but at the main knitting station M, and a drop throat plate 20 may be used to form a satisfactory terry loop fabric. Also, fabric may be knit in a multifeed manner in any desired area of the sock. For example, plain courses may be knit in a two-feed manner by feeding yarns to all of the cylinder needles at the main station M and at the auxiliary station A. In this case, the cams 32, 36 and 57 will be moved inwardly to raise all cylinder needles at each station.

With the selector means positioned in advance of each knitting station, it is also possible to form a wide variety of different patterns of plain, tuck and float stitches. Therefore, the present machine may be used in the multifeed knitting of ladies' and children's stockings having tuck, float and plain stitch patterns formed in selected portions, such as the leg and foot. This type of patterned stockings may be provided with ribbed and/or terry portions, if desired.

Thus, the machine of the present invention is adaptable to selectively knit sections of ribbed fabric and sections of terry loop fabric in a single feed manner, or to knit sections of plain patterned fabric in a two-feed manner.

In the drawings and specification there have been set forth several preferred embodiments of the invention and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

We claim:

1. In a circular hosiery knitting machine including a set of cylinder needles, means for rotating and reciprocating said cylinder needles, a set of dial needles, and spaced apart first and second knitting stations, the combination therewith of

(a) means at said first knitting station capable of selectively forming only terry loop and plain fabric on said cylinder needles, and

(b) means at said second knitting station capable of selectively forming only ribbed and plain fabric on said cylinder and dial needles, and wherein only one of said knitting stations operates during the knitting of the terry and the ribbed fabrics.

2. A circular knitting machine according to claim 1 including sinkers cooperating with said cylinder needles during knitting and having nibs thereon, and wherein said terry loop fabric forming means (a) includes

(1) a set of stitch cams operable on said cylinder needles to impart stitch forming motions thereto during both rotation and reciprocation of said cylinder needles,

(2) a throat plate having a portion depending downwardly below the level of said dial needles, and

(3) means for feeding a body yarn at a low level in said throat plate while feeding a terry yarn at a higher level in said throat plate so that said cylinder needles draw the body yarn down over said sinkers and below said nibs while drawing the terry yarn down over said nibs.

3. A circular knitting machine according to claim 1 wherein said ribbed fabric forming means (b) includes

(1) stitch cam means operable on said cylinder needles to impart stitch forming motions thereto during rotation of said cylinder needles,

(2) a throat plate having a lower level above the level of said dial needles,

(3) stitch cam means operable on said dial needles to project the same outwardly beneath said throat plate during stitch forming motions, and

(4) means for feeding yarn to said cylinder and dial needles at said throat plate.

4. A circular knitting machine according to claim 3 including pattern jack means positioned beneath said needles, and selector means positioned in advance of said second knitting station for selecting certain of said cylinder needles to knit thereat.

5. A circular knitting machine according to claim 2 including pattern jack means positioned beneath said needles, and selector means positioned in advance of said first knitting station.

6. A circular knitting machine according to claim 1 including sinkers cooperating with said cylinder needles during knitting and having nibs thereon, and wherein said terry loop fabric forming means (a) includes

(1) a set of stitch cams operable on said cylinder needles to impart stitch forming motions thereto during both rotation and reciprocation of said cylinder needles,

(2) a throat plate having a portion depending downwardly below the level of said dial needles, and

(3) means for feeding a body yarn at a low level in said throat plate while feeding a terry yarn at a higher level in said throat plate so that said cylinder needles draw the body yarn down over said sinkers and below said nibs while drawing the terry yarn down over said nibs, and,

wherein said ribbed fabric forming means (b) at said second knitting station includes

(1) stitch cam means operable on said cylinder needles to impart stitch forming motions thereto during rotation of said cylinder needles,

(2) a throat plate having a lower level above the level of said dial needles,

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(3) stitch cam means operable on said dial needles to project the same outwardly beneath said throat plate during stitch forming motions, and

(4) means for feeding yarn to said cylinder and dial needles at said throat plate.

7. A circular knitting machine according to claim 6 including pattern jack means positioned beneath said needles, selector means positioned in advance of said second knitting station for selecting certain of said cylinder needles to knit thereat, and selector means positioned in advance of said first knitting station.

8. A method of knitting a sock on a circular knitting machine having a set of cylinder needles, means for rotating and reciprocating said cylinder needles, a set of dial needles, and a pair of spaced-apart knitting stations, said method comprising the steps of

(a) knitting on said cylinder and dial needles at only one of said knitting stations to form ribbed fabric in a selected portion of the sock, and

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(b) knitting only on said cylinder needles at only the other of said knitting stations to form terry loop fabric in another selected portion of the sock.

9. A method of knitting according to claim 8 wherein said step (a) takes place during rotation of said cylinder needles, and wherein said step (b) takes place during both rotation and reciprocation of said cylinder needles.

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