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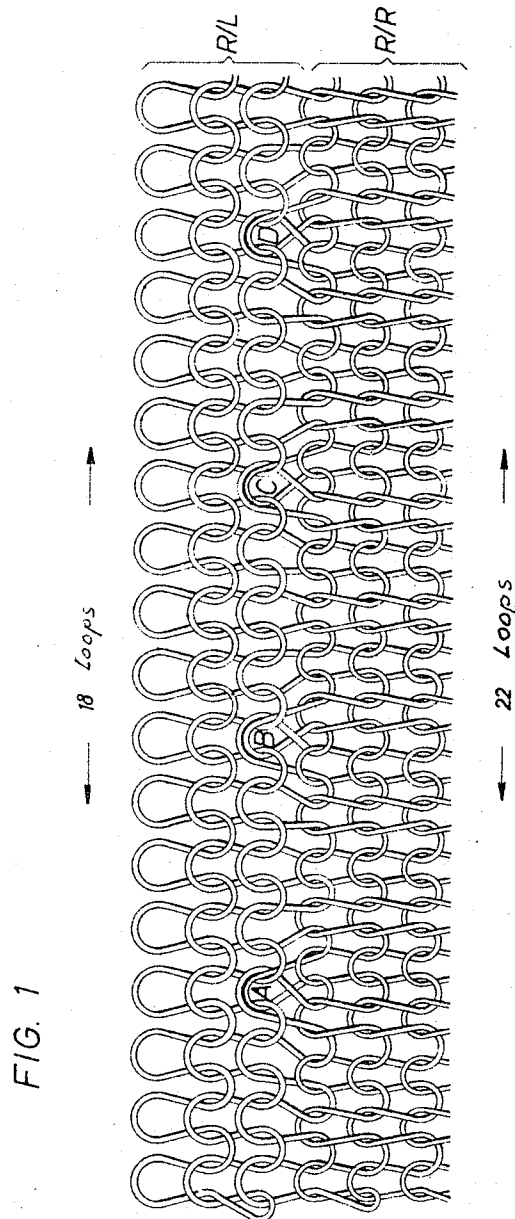
H. SCHELLER ET AL

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CONNECTION BETWEEN PLAIN AND RIBBED FABRICS

Filed July 27, 1965

6 Sheets-Sheet 1



INVENTORS:  
HANS SCHELLER  
JOACHIM SCHELLER  
By: Michael S. Hike,  
ATTORNEY

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H. SCHELLER ET AL

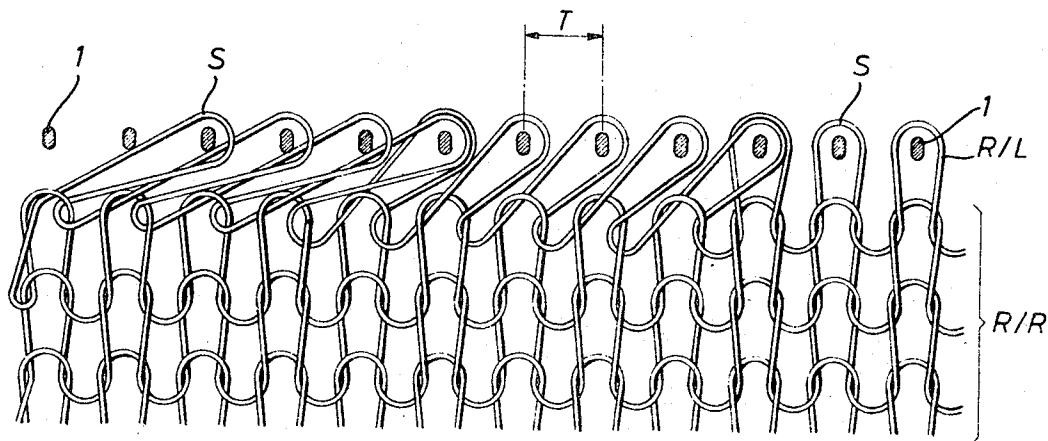
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CONNECTION BETWEEN PLAIN AND RIBBED FABRICS

Filed July 27, 1965

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FIG. 2



INVENTORS:

HANS SCHELLER

JOACHIM SCHELLER

By: Michael S. Hines  
ATTORNEY

April 9, 1968

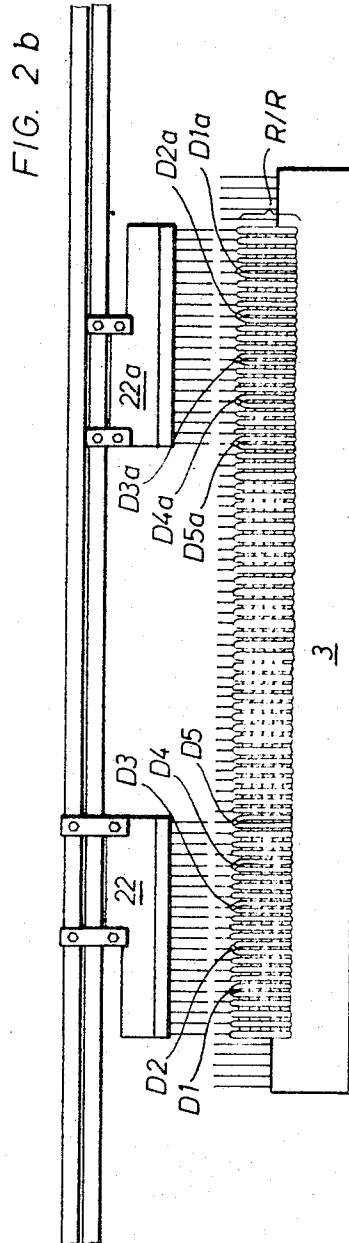
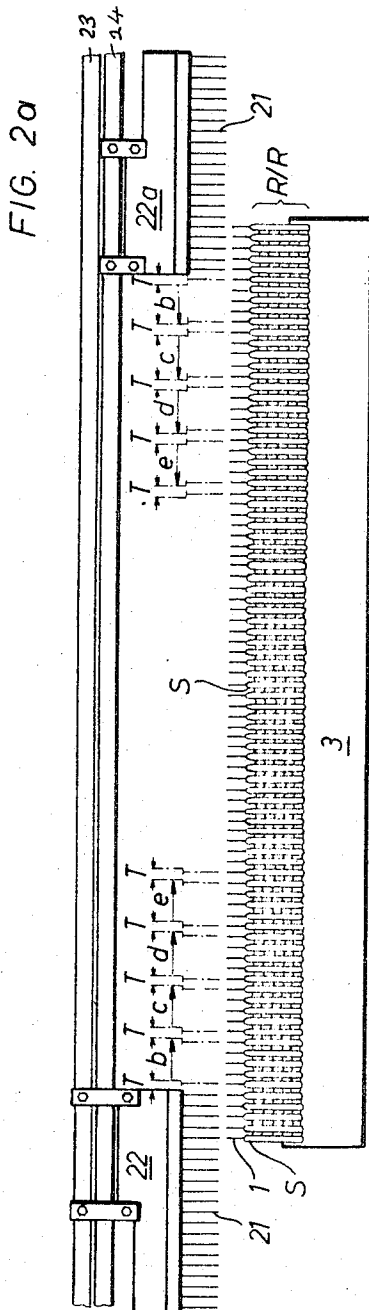
H. SCHELLER ET AL

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CONNECTION BETWEEN PLAIN AND RIBBED FABRICS

Filed July 27, 1965

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INVENTORS  
HANS SCHELLER  
JOACHIM SCHELLER  
BY: MICHAEL S. MILLER  
ATTORNEY



April 9, 1968

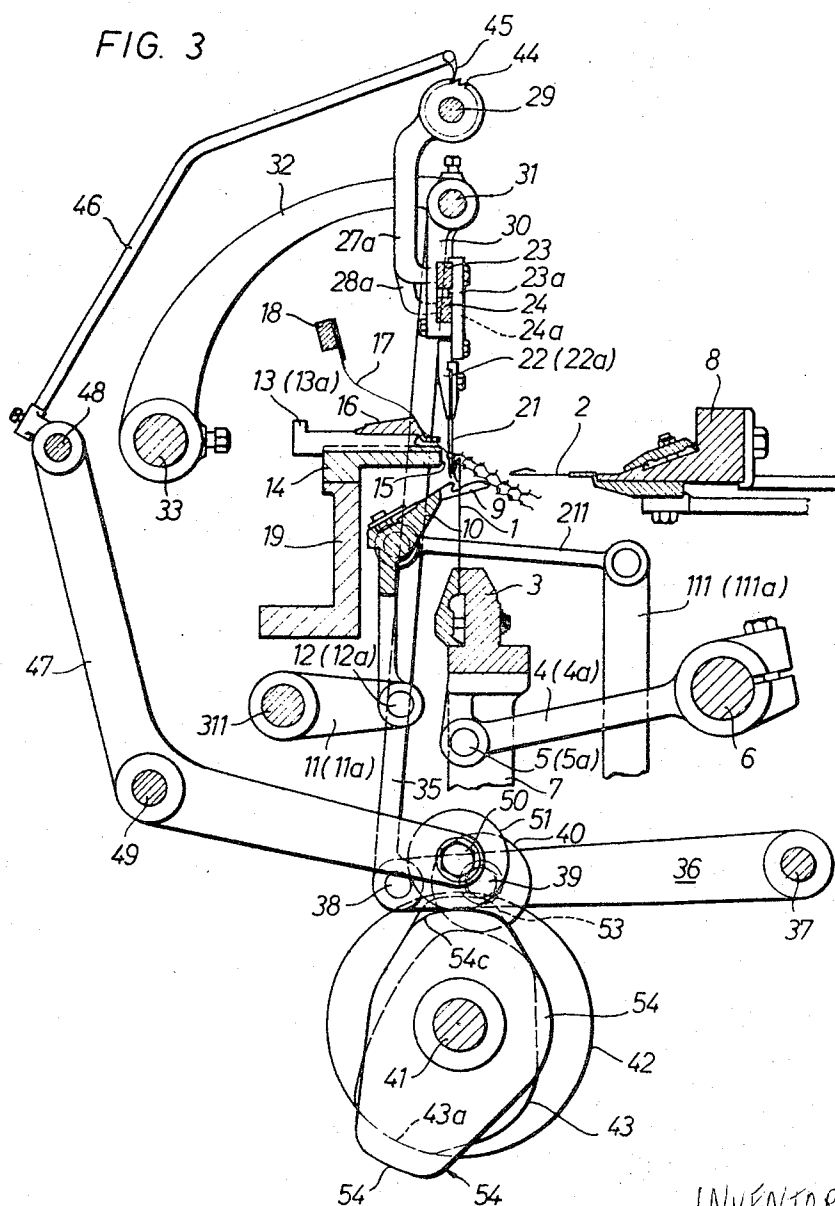
H. SCHELLER ET AL

3,376,717

CONNECTION BETWEEN PLAIN AND RIBBED FABRICS

Filed July 27, 1965

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INVENTORS:  
HANS SCHELLER  
JOACHIM SCHELLER  
By: Michael S. Hiker  
ATTORNEY

April 9, 1968

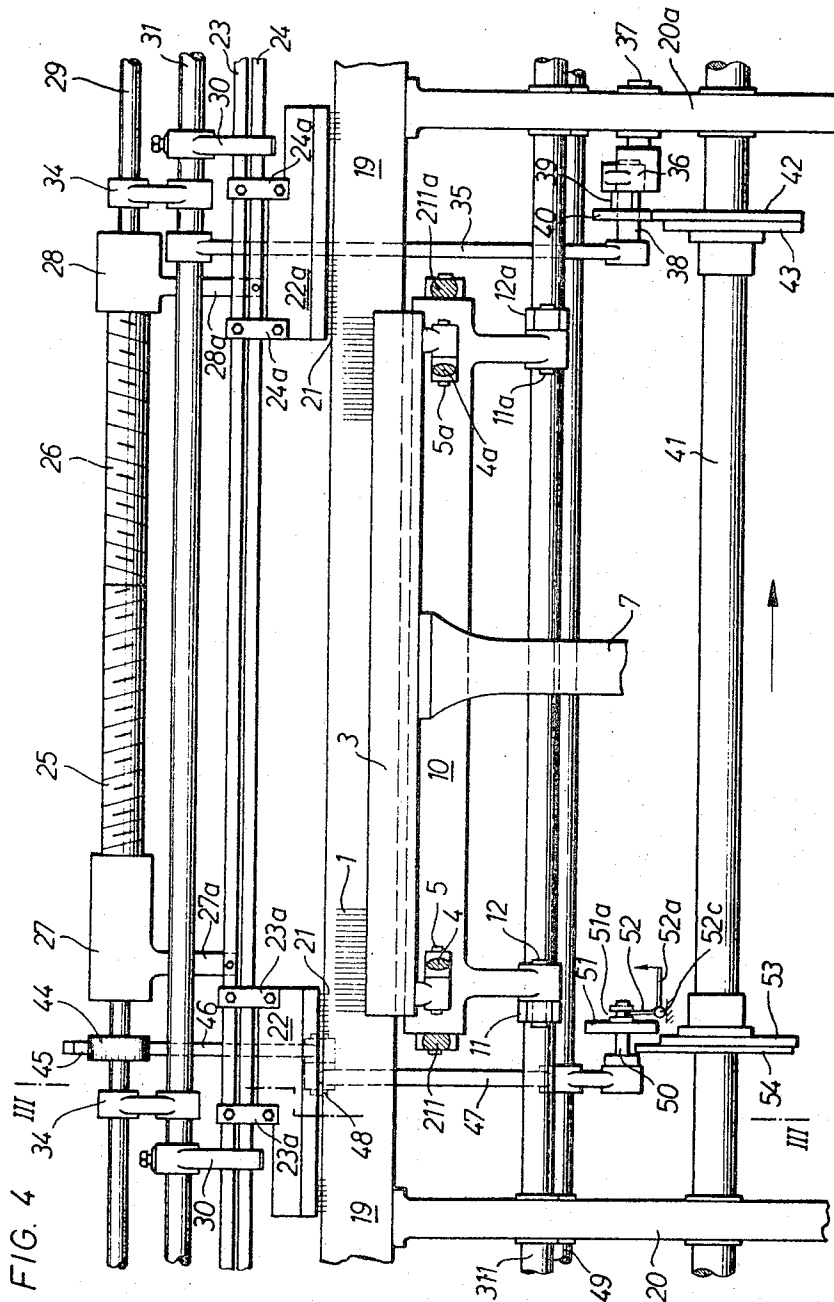
H. SCHELLER ET AL

**3,376,717**

## CONNECTION BETWEEN PLAIN AND RIBBED FABRICS

Filed July 27, 1965

6 Sheets-Sheet 6



INVENTORS,  
HANS SCHELLER  
JOACHIM SCHELLER  
By: Michael S. Spiker  
ATTORNEY

1

3,376,717

## CONNECTION BETWEEN PLAIN AND RIBBED FABRICS

Hans Scheller, Faurndau, Wurttemberg, and Joachim Scheller, Heiningen, Wurttemberg, Germany, assignors to Gebr. Scheller Textilmaschinenfabrik GmbH, Eisingen (Fils), Germany

Filed July 27, 1965, Ser. No. 475,078

Claims priority, application Germany, July 28, 1964, Sch 35,541

10 Claims. (Cl. 66—199)

### ABSTRACT OF THE DISCLOSURE

A ribbed knitted fabric portion is connected with a plain knitted fabric portion by a transition course having a number of equally spaced double loops so that the plain fabric portion has fewer wales than the ribbed fabric portion. The number of double loops is selected in accordance with the used yarn so that the plain and ribbed fabric portions have the same width in the direction of the courses.

#### Background of the invention

The present invention relates to a connection between ribbed and plain knitted fabrics, and more particularly to a method and apparatus for producing a plain knitted fabric having a marginal ribbed knitted fabric portion and to the produced fabric.

It is known that a ribbed knitted fabric has a smaller width than a plain knitted fabric having the same number of wales. Consequently, when a ribbed fabric portion is directly knitted to a plain fabric portion, the plain fabric portion is wider than the ribbed fabric portion which is undesirable for garments, such as sweaters, and particularly for sleeves.

#### Summary of the invention

It is the object of the present invention to overcome this disadvantage of known knitted fabrics composed of a ribbed and of a plain fabric portion, and to provide a fabric of uniform width consisting of ribbed and plain fabric portions.

Another object of the invention is to provide a method for knitting a plain fabric portion to a ribbed fabric portion in such a manner that the two fabric portions form a knitted fabric of uniform width.

Another object of the invention is to form uniformly spaced double loops in the first row of a plain fabric knitted to the last row of a ribbed fabric so that the number of wales of the continued plain knitted fabric is smaller than the number of wales and loops of the ribbed fabric, the number of double loops being selected so that the plain and ribbed fabrics have the same width.

Another object of the invention is to provide a straight bar knitting machine with apparatus for carrying out the method of the invention.

Another object of the invention is to control the narrowing heads of a Cotton type straight bar knitting machine by control means to form spaced double loops so that the number of wales and the width of the plain knitted fabric portion are reduced conforming to the width of the ribbed fabric portion.

With these objects in view, the present invention is concerned with a composite knitted fabric, with a method of making the same, and with an improved knitting machine for making a fabric in accordance with the method of the invention.

A composite fabric according to the present invention comprises a ribbed fabric portion and a plain fabric por-

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tion knitted together, the plain fabric portion having a smaller number of wales than the ribbed fabric portion, and the ribbed and plain fabric portion being of equal width. In order to reduce the number of loops of the plain fabric portion, double loops are formed spaced equal distances from each other in a transition row between the plain and ribbed fabric portions which may be considered the last row of the ribbed fabric portion, or to be connected with the last row of the ribbed fabric portion.

Consequently, in accordance with the method of the invention, double loops are formed at equal distances along the first row of a ribbed fabric knitted to a plain fabric portion so that the width of the plain knitted fabric is the same as the width of the ribbed fabric portion.

An embodiment of the apparatus of the invention includes cam means controlling the narrowing heads of a full fashioned straight bar knitting machine of the cotton type in such a manner that loops are repeatedly transferred in the same row of loops until a sufficient number of double loops is produced equally spaced from each other whereby the width of the plain fabric portion is reduced to such an extent as to be equal to the width of the ribbed fabric portion.

The straight bar knitting machine on which the fabric is made in accordance with the invention, is of the well known type in which twice as many vertical needles than horizontal needles are used for making a ribbed fabric. Loops are formed on every alternate vertical needle only, while the intermediate vertical needles are pressed and transfer the yarn to the respective horizontal needles, whose number is half the number of all vertical needles and on which rib loops are formed. During the knitting of the ribbed fabric, there is a phase when all loops are on the vertical needles, and in accordance with the invention, selected loops are transferred in this phase to adjacent vertical needles to form double loops while all loops are on the vertical needles.

After a row of loops has been transferred from the horizontal needles of the knitting machine to the vertical needles, the narrowing heads, or other transfer means having transfer points, transfer a predetermined number of loops from a group of adjacent vertical needles one needle distance to a corresponding group of vertical needles so that a double loop is formed on one needle. Another group of loops is picked up by the shifted transfer means, including the double loop, and is shifted another needle distance so that the double loop is transferred another needle distance, and a new double loop is formed. This operation is continued until uniformly spaced double loops are formed along the entire row of loops, preferably by simultaneous operation of two transfer means moving in opposite directions toward, or away from each other. As many transfer operations are required, as are double loops necessary to reduce the number of loops and wales of the plain fabric portion sufficiently to reduce the width of the plain fabric portion to correspond to the width of the ribbed fabric portion.

After each shifting of the transfer means, a greater number of loops must be picked up and transferred, so that a greater number of transfer points is used for each successive transfer operation, if the transfer means are shifted in the same direction to new groups of loops as they are shifted one needle distance with a group of loops. On the other hand, if the transfer means are shifted without loops in the opposite direction than when shifted one needle distance with the loops, the number of transfer points used during successive shifting operations is reduced.

The narrowing heads of the Cotton type knitting machines are operated to increase or decrease the width of the fabric by increasing or reducing the number of loops

in successive rows. In this operation, the number of loops in successive rows is reduced by no more than two loops. In contrast thereto, in accordance with the present invention, the narrowing heads are used only in a transition row forming the last row of the ribbed fabric portion, and the number of loops in this row is substantially reduced by making a plurality of uniformly spaced double loops along the row.

The pair of narrowing heads provided in each section of a standard knitting machine may be used in the apparatus of the invention in combination with particular cam control means, but it is necessary that the two narrowing heads extend almost along half the entire length of the row of vertical needles in the respective section of the knitting machine, since otherwise a uniform distribution of the required number of double loops over the length of the row of loops would not be possible. If the narrowing heads are narrower, the double loops can only be distributed over parts of the row of loops which would render the plain fabric portion less uniform.

In one arrangement of the present invention, the two narrowing heads are in an initial position at the ends of the needle bar of the vertical needles after the loops have been transferred from the horizontal needles to the vertical needles. Moving toward each other, the narrowing heads, after transferring loops to adjacent needles for one needle distance, are shifted a predetermined number of needle distances to pick up the double loop formed by the previous one step motion. This operation is repeated, until the narrowing heads arrive at the center of the row of vertical needles. After all double loops have been formed, the two narrowing heads have to be moved away from each other back to the initial position so that the narrowing heads are in positions permitting the conventional fashioning operation by increasing or decreasing the number of loops in successive rows of the plain fabric.

In another arrangement of the invention, the narrowing heads start the operation at the center of the row of needles spaced a number of needles, for example eight needles, from each other. Loops are picked up by the narrowing heads or transfer means and are transferred one step toward the center to form double loops. Thereupon, the transfer means are shifted a predetermined number of needle distances in outward direction, pick up a smaller number of loops than before, and shift the same one needle distance toward the center. This operation is repeated as often as required for making the corresponding number of double loops by each transfer means. After all operations have been carried out and the necessary number of double loops has been formed, the transfer means or narrowing heads are in the initial position at the ends of the needle bar and ready for the conventional fashioning operations.

In this method of the present invention, the fashioning heads or transfer means have to be moved in opposite directions since they move inwardly for forming double loops, and outwardly for picking up a group of loops. This requires an additional control mechanism.

For carrying out the method in which the transfer means moves inwardly toward each other one step for forming double loops, and several steps for picking up new groups of loops, the movement of the transfer means is controlled by a cam on the cam shaft of the machine. This control cam has two cam lugs of different height, the lower cam lug causing a one step movement of the transfer means, and the higher cam lug causing a movement of the transfer means for several steps corresponding to a group of needles.

Since the transfer means are used for standard fashioning operations, as well as for the shifting operations of the invention, the cam follower means which control the narrowing heads or transfer means selectively cooperate with the control cam of the present invention, and with the standard cam used in conventional machines for controlling the fashioning operations. The cams may be

shifted in axial direction, and locked while controlling either fashioning operations, or the transfer operations according to the invention.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings therefore

#### *Brief description of the drawing*

FIG. 1 is a fragmentary plan view illustrating a portion of a composite knitted fabric in accordance with the invention;

FIG. 2 is a fragmentary plan view illustrated the formation of double loops in accordance with the method of the invention;

FIGS. 2a and 2b are fragmentary schematic elevations illustrating two different operational positions of fashioning heads operated in accordance with a first method of the invention;

FIGS. 2c and 2d are fragmentary schematic elevations illustrating two different operational positions of fashioning heads operated in accordance with a second method of the invention;

FIG. 3 is a fragmentary vertical sectional view illustrating a Cotton type straight bar knitting machine provided with the apparatus of the invention, conventional parts being omitted for the sake of simplicity, and a section being taken along line III—III in FIG. 4; and

FIG. 4 is a fragmentary elevation illustrating the machine shown in FIG. 3, with conventional parts omitted for the sake of simplicity.

#### *Description of preferred embodiments*

Referring first to FIG. 1, a composite knitted fabric according to the present invention comprises a ribbed fabric portion R/R and a plain fabric portion R/L. Only four rows of the ribbed portion, and two rows of the plain fabric portion in the left part of the fabric are shown. The left end of FIG. 1 is a selvedge, whereas the right end of FIG. 1 may be continued in a manner not shown to the other selvedge of the composite fabric. It will be seen that the illustrated part of the fabric has the same width in the region of the ribbed fabric portion as in the region of the plain fabric portion although the loops of the plain fabric portion are wider and require more space. The width of the plain fabric portion is reduced by providing only eighteen loops and wales in this portion, as compared with twenty-two single loops and wales in the ribbed portion.

In order to provide the transition from the greater number of loops to the smaller number of loops, every fourth loop of the last row of the ribbed fabric is a double loop, four double loops A, B, C, D being shown, corresponding to the reduction of the twenty-two loops of the ribbed fabric to the eighteen loops and wales of the plain fabric.

The ribbed fabric portion has been formed in the usual manner by the cooperation of the vertical and horizontal needles of a straight bar Cotton type knitting machine, and a transition row and the first row of the plain fabric portion are formed when the loops of the ribbed fabric portion hang on the vertical needles. The double loops are formed of two loops of the transition row and hang on the vertical needles until they are knocked over together with the single loops of the same row over the newly formed loops of the first row of the plain fabric. Consequently, the loops of the plain fabric are suspended on eighteen needles, while the loops of the ribbed fabric were suspended on twenty-two vertical needles.

However, this ratio between the loops of the ribbed and plain fabric is given by way of example only, and the number of loops and wales of the plain fabric portion must be reduced as compared with the number of

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loops of the ribbed fabric portion in such a ratio that the plain and ribbed fabric portions have the same width, which depends on the material of the yarn and the needle pitch of the knitting machine. The number of double loops consequently depends on several factors, but it is possible to determine for each composite fabric the required number of double loops for producing the desired result, namely uniform width of a composite fabric including plain and ribbed fabric portions.

Referring now to FIG. 2 which illustrates the manner in which a selected number of double loops are formed along the first row of the plain fabric, the four rows of the ribbed fabric portion R/R are first knitted. When the loops of the fourth row were still suspended on the vertical needles 1, of which twelve are shown in cross section, four points of a transfer means, such as a narrowing head, had picked up the first four loops from the first four needles on the left, and transferred them one needle distance so that the four loops were transferred to the second to the fifth needle, forming a double loop on the fifth needle. Thereupon, the transfer means was shifted and the loops of the second to ninth needles, including the double loop on the fifth needle, were picked up by eight transfer points, and transferred, as before, one needle distance from the left to the right so that the loops are now suspended on the third to tenth needle, as shown in FIG. 2. The first double loop was transferred from the fifth needle to the sixth needle, and a new double loop was formed on the tenth needle. Since the first loop was shifted twice the needle distance T, the two first needles on the left are now free. The operation is repeated until every fourth loop of the last row of the ribbed fabric is a double loop, as shown for the double loops A to D in FIG. 1. The number of needle distances which the double loops are spaced from each other, corresponds to the number of needle distances through which the loops were shifted.

FIGS. 2a and 2b illustrate one method for using the narrowing heads 22, 22a of a full fashioned knitting machine as transfer means in accordance with the invention. Each transfer means 22, 22a has twenty-one transfer points 21 and is secured by brackets to a rod 23, or 24, respectively. These rods are controlled by means which will be described hereinafter with reference to FIGS. 3 and 4 to perform stepwise movements together with the transfer means 22, 22a from the ends of the needle bar 3 with the vertical needles 1 toward the center of the needle bar. The transfer means 22, 22a are also operated to move up and down for picking up loops from the vertical needles 1, and to place the picked up loop again on other needles so that the loops are transferred. The apparatus by which these movements are accomplished will be described hereinafter, and is partly also used during standard fashioning operations performed by transfer means 22, 22a serving as narrowing heads.

The transfer points are first moved down to interlock with the needles and to cause the needle beards to be pressed into the grooves of the points. This closes the needle beards and allows the points, which have partly passed through the last knitted loops, to remove the loops from the needles. The transfer means are then raised a sufficient distance to cause the transfer points to clear the needle tips.

After the transfer means have been shifted, as will be explained hereinafter, the transfer means are lowered, and the transfer points transfer the previously picked up loop back to the needles.

In the operation illustrated in FIGS. 2a and 2b, five transfer points 21 are located opposite the five first needles 1 at opposite ends of the row of needles. It is assumed that the needle bar carries seventy-seven vertical needles on which seventy-seven loops of the first row of the plain knitted fabric are suspended. By operation of the transfer means 22, 22a, the first five loops at either end of the needle row are picked up, whereupon the transfer means

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22, 22a are moved inwardly one step corresponding to one needle distance T, and then the five picked up loops are placed on the second to sixth needles at either end, forming a double loop on the sixth needle.

Both transfer means 22, 22a are now shifted a distance b corresponding to four needle distances T. The transfer means are again lowered so that the first nine transfer points pick up the loops of the second to tenth needles on either end, including the double loop on the sixth needles, whereupon the transfer means are shifted one step corresponding to the needle distance T so that a new double loop is formed on the eleventh needles, while the first transfer loops, respectively, are transferred from the sixth needles to the seventh needles counting inwardly from the ends. The transfer means 22 and 22a are again shifted inwardly distances c corresponding to four needle distances T, the corresponding loops are picked up in a new position, and transferred one needle distance, forming third double loops on the sixteenth needles. The first formed double loops are now suspended on the eighth needles, and the second formed double loops are now suspended on the twelfth needles.

Thereupon, the transfer means 22 and 22a are again inwardly shifted a distance d, pick up the corresponding loops, and transfer the same one step to the next needles so that new double loops are formed, and the first formed double loops are transferred to the ninth needles. The operation is again repeated, and after the transfer means has been shifted the distance e, and transferred the loops another step inwardly, the first formed double loops are located on the tenth needles in the positions D1 and D1a, as shown in FIG. 2b. On either end of the needle bar 3, five double loops D1 to D5 and D1a to D5a are formed, and the five first needles at either end of needle bar 3 are free of loops. The double loops are respectively located on the tenth, fourteenth, eighteenth, twenty-second and twenty-sixth needle counted inwardly from the ends of the needle row. During the continuation of the knitting of the plain fabric portion R/L shown in FIG. 1, the number of loops in each row, and the number of corresponding wales, is reduced by ten, as compared with the number of wales of the ribbed fabric portion R/R. It is assumed that the thickness of the needles, the needle distances, and the yarn used have such properties that the seventy-seven loops of the ribbed fabric will have the same width as the sixty-seven loops of the plain knitted fabric so that the composite fabric has straight parallel selvages.

In the method of the invention described with reference to FIGS. 2a and 2b, the transfer means 22, 22a start the operation at the outer ends of the row of needles and move stepwise inward performing alternately one step for forming double loops, and a greater number of steps corresponding to needle distances for spacing the double loops the same number of needles.

In the method illustrated in FIGS. 2c and 2d, the transfer means 21 and 22a start the operation in an initial position located inwardly of the ends of the needle row, as shown in FIG. 2c, and end the operation in an outer farther spaced position located in the region of the ends of the row of needles. The one step transfer movement is carried out inwards, with the transfer means 22 and 22a moving toward each other, and the shifting movements of the transfer heads for several needle distances are carried out in outward direction with the transfer means 22, 22a moving apart.

In the initial position shown in FIG. 2c, the twenty-one transfer points of each transfer means 22, 22a are located opposite twenty-one needles 1, the outermost transfer points being located opposite the sixth needles from the ends of the row.

Transfer means 22, 22a are simultaneously operated so that the transfer points of each transfer means 22, 22a pick up twenty-one loops. The transfer means are respectively moved one step toward each other so that the inner-

most transfer points produce double loops DD1 and DD1a. Thereupon, both transfer means are moved apart distances *b* corresponding to five needle distances, the next group of loops, which does not include the first formed double loops, is picked up and transferred one step corresponding to one needle distance *T* in inward directions so that the second double loops DD2 and DD2a are formed spaced four needle distances *T* from the first formed double loops. The transfer means 22, 22a are then shifted apart distances *c*, and operated to pick up new groups of loops and to transfer them one needle distance inward to form the third double loops DD3 and DD3a. Finally, the transfer means are shifted apart distances *a*, and then transfer a new group of loops inwardly one step to form the last double loops DD4 and DD4a. The method described with reference to FIGS. 2a and 2b has the advantage that the transfer means 22 and 22a move in the same direction during shifting and transfer motions. Consequently, a lesser number of transfer points is required for each transfer means than in the method described with reference to FIGS. 2c and 2d. However, the method according to FIGS. 2c and 2d has the advantage that the transfer points are not used for picking up double loops, as in the method described with reference to FIGS. 2a and 2b, but engage and transfer only single loops.

Referring now to the full fashioned knitting machine of the Cotton type illustrated in FIGS. 3 and 4, the general construction of this machine is well known, and certain conventional parts of the machine are omitted for the sake of simplicity.

A needle bar 3 carries a row of vertical needles 1, and a needle bar 8 carries a row of horizontal needles 2. The operation of the needle bar 8 during the knitting of the ribbed fabric portion is no part of the present invention, and consequently the horizontal needles 2 and needle bar 8 are illustrated only in FIG. 3, and omitted in FIG. 4.

The up and down motion of needle bar 3 with needles 1 is effected by a pair of arms 4 and 4a connected by pivots 5, 5a to needle bar 3 and fixedly clamped to a needle bar shaft 6 which extends along the entire length of the machine and is operated in the usual manner by cams to be rocked for moving needle bar 3 up and down.

Needle bar 3 and needles 1 perform a composite movement including a horizontal component which is required for the pressing of the needle beards. The horizontal movement is produced by an arm 7 connected to cam driven levers, not shown, and turning with the needle bar about pivots 5, 5a. Knock over means 9 are shown in FIG. 3 to be mounted in a knock over bar 10 which is movable in a composite movement including vertical and horizontal components. Bar 10 is pivotally connected by pivots 12 and 12a to a pair of levers 11 and 11a mounted on the knock over shaft 311 which extends for the entire length of the machine. Shaft 311 is turned in the usual manner by cam controlled levers.

The knock over bar 10 is pivotally connected with a pair of levers 211, 211a which are articulated to a pair of levers 111, 111a driven to rock about horizontal axis to cause knock over bar 10 to move in a horizontal motion. These motions are produced by cams, not shown, in the usual manner.

Sinkers 13 and dividers 13a are mounted in a support 14 for reciprocating horizontal movement. The front edge 15 of support 14 is used for pressing the beards of the vertical needles 1. A head portion 16 closes the slots of support 14 in which the sinkers and dividers are mounted. The sinker head 14, 16 is located under bar 18 which carries thread guides 17. The means by which the sinker head and sinkers are operated are well known and not illustrated in the drawing.

Sinker head 14, 16 is mounted on a support 19 which extends for the entire length of the knitting machine, and is secured to several vertical frame walls of which walls 20 and 20a are illustrated in FIG. 4.

Full fashioned knitting machines of this type are provided with narrowing apparatus in each section of the machine cooperating with the respective needle bar 3 and needles 1. Each narrowing apparatus includes two narrowing heads or fingers 22, 22a which are located at the ends of the needle bar 3 when not in use. Each narrowing head carries a row of transfer points 21 which during the conventional operations of the narrowing heads 22, 22a cooperate with the vertical needles 1 to pick up and transfer loops from the same to adjacent needles. When the width of the fabric has to be narrowed, the narrowing heads are operated to transfer one or two loops inwardly from the outermost needles in each successive row, or in a number of rows spaced predetermined distances whereby the width of the fabric is gradually diminished whereby a fabric contour is obtained in accordance with the requirements of a fashioned garment.

The apparatus of the present invention uses the known narrowing heads of standard knitting machines in combination with other elements for a different purpose, as explained above.

Each narrowing head or transfer means 22, 22a is secured by bracket 23a, 24a to one of the narrowing rods 23, 24 which extends for the entire length of the machine, and are mounted in bearings 30 for longitudinal movement with the transfer means 22, 22a parallel to the needle bar 3 and the row of needles 1. Bearings 30 are secured to a so-called narrowing shaft 31 which is mounted in arms 32 for turning movement and secured against movement in axial direction. As shown in FIG. 3, arms 32 are secured to a shaft 33 which is mounted in frame walls 20, 20a for turning movement so that all arms 32 can turn about the axis of shaft 33 for moving shaft 31, rods 23 and 24, and transfer means 22, 22a up and down. During the thus produced downward movement, the transfer points 21 pass into the loops *S* on needles 1, and during the upward movement of the transfer points, the picked up loops are lifted from the needles. This up and down motion takes place under the control of a rod 35 whose upper end is secured to shaft 31, and whose lower end is pivotally connected by pivot 38 to a cam follower lever 36 which is mounted for rocking movement on a pivot 37 on wall 20, and carries a pin 39 on which a cam follower roller 40 is turnably mounted.

The weight of the assembly including the lever 36, rod 35, shaft 31 and transfer means 22, 22a urges roller 40 into engagement with one of two discs 42 and 43 which are secured to cam shaft 41 adjacent each other. Disc 42 is circular, and disc 43 is a cam having a contour best seen in FIG. 3.

While the narrowing heads are inoperative and in the position shown in FIG. 4, follower roller 40 is located on the circular disc 42 so that the narrowing heads 22, 22a remain motionless in the highest position. When shaft 41 is shifted out of the position shown in FIG. 4 toward the right, follower roller 40 slides off circular disc 42 and onto the peripheral track of cam 43 so that the narrowing heads 22 and 22a are moved up and down in accordance with the shape of cam 43. Shaft 41 is mounted in bearings of walls 20, 20a for axial movement, and is shifted by the conventional manually operated means for rendering discs 42 and 43 selectively operative depending on whether a narrowing operation is desired or not.

Shaft 41 carries another pair of cams 53 and 54 which control the horizontal motion of the narrowing heads 22, 22a. In the position shown in FIG. 4, in which disc 42 holds the narrowing heads in the highest inoperative position, cams 53 and 54 are inoperative since they are not engaged by a cam follower roller. However, when shaft 41 is manually shifted to the position in which cam 43 is operative to raise and lower the narrowing heads, cam 53 is shifted to a position cooperating with a cam follower roller 51 which is carried by the pivot 50 of a double armed lever 47. Cam 53 controls the one step

movement of the narrowing head for a needle distance T when the width of the fabric is to be diminished. Lever 47 is mounted on a stationary shaft 49 and is connected at the upper end thereof by a pivot 48 to a control rod 46 which carries a pivoted pawl 45 on the free end thereof.

Pawl 45 cooperates with a ratchet wheel 44 which is secured to a shaft 29. Shaft 29 has opposite left and right threads 25 and 26 on which nuts 27 and 28 are mounted. Arms 27a and 28a of nuts 27 and 28 are respectively secured to the narrowing rods 23 and 24. When shaft 29 is turned, spindles 27 and 28 are moved in opposite directions, and move the rods 23, 24 so that the narrowing heads 22 and 22a either move away from each other, or toward each other depending on the direction of rotation of shaft 29 and ratchet wheel 44. The pitch of the threads is selected so that each narrowing head 22, 22a is shifted one step corresponding to the distance between two adjacent needles when pawl 45 turns ratchet wheel one step to engage the next following tooth of the ratchet wheel. Spindle shaft 29 is secured against movement in axial direction by bearings 34 which are mounted on the supporting shaft 31.

Cam 53 controls the movement of the assembly 51, 47, 46 in synchronism with the up and down movement of the narrowing heads produced by cam 43 so that both narrowing heads are shifted one step corresponding to the needle distance T toward each other while the narrowing heads are raised to a position in which the transfer points 21 are located above needles 1. As explained above, this is accomplished by shifting ratchet wheel 45 by pawl 45 one step.

Cams 43 and 53 are simultaneously effective for reducing the width of a fabric in the usual manner in a plurality of successive rows of loops.

In accordance with the present invention, an additional cam 54 is secured to shaft 41 for cooperation with cam follower roller 51. However, since shaft 41 of the standard machine cannot be shifted to a position in which cam 54 cooperates with roller 51, means are provided in accordance with the present invention for shifting the cam follower roller 51 in axial direction. Roller 51 is mounted on a pivot pin 50 on lever 47 so as to be shiftable in axial direction, and has a hub portion formed with a peripheral annular groove 51a in which the forked end portions of a bell crank lever 52 are located. Lever 52 is mounted on a stationary pivot 52c for turning movement and is operated by application of a force to the free lever arm 52a. The lever arm 52a is connected to control means which are operated by the pattern chains of the machine, or by a manual operation, so that when an operation according to the present invention is to be carried out, roller 51 is shifted on pivot 50 to a position cooperating with cam 54 if the same has been shifted to the right as viewed in FIG. 4 to a position in which cam 43 cooperates with roller 40 to render the narrowing heads operative. Lever 52 and roller 51 are arrested in the operative position in the usual manner.

When the machine is to be operated in accordance with the invention, cam 43 controls the vertical movements of the transfer means 22, 22a for picking up and depositing loops, and cam 54 controls the horizontal movements of the transfer heads required for transferring picked up loops one needle distance, and also for shifting the transfer means without loops to new positions in which other loops are picked up, as explained with reference to FIGS. 2a to 2d.

Cam 54 has two substantially diametrically arranged lugs 54a and 54c. When lug 54c engages roller 51, assembly 51, 47, 46 operates pawl 45 to shift ratchet wheel 44 and shaft 29 one step so that the transfer means 22 and 22a respectively perform single steps toward each other for transferring a group of picked up loops to the respective adjacent needles.

After about half a revolution of shaft 41, lug 54a en-

gages cam follower roller 51. This lug is higher than lug 54c so that lever 47 and rod 46 are shifted a greater angle, determined by the shape of cam lug 54c and corresponding to a shifting of the ratchet wheel 44 for several angular steps. Cam lug 54a is angularly positioned in relation to the cam lug of cam 43 so that the transfer heads are shifted several needle distances under the action of cam lug 54a, while cam 43 holds transfer means 22, 22a in the highest position, and while the transfer points 21 carry no loops. After completion of the longer shifting movement produced by cam lug 54a, cam 43 effects lowering of the transfer means 22, 22a so that new loops are picked up to be transferred one needle distance to adjacent needles under the control of cam lug 54c.

The shape of cam lugs 54a and 54c shown in FIG. 3 is designed to operate the transfer means 22, 22a in the manner described with reference to FIGS. 2a and 2b.

When the method described with reference to FIGS. 2c and 2d is to be carried out, cam lug 54a must be designed to cause movement of the transfer means 22, 22a away from each other, which is accomplished by reducing the height of the respective cam lug below the height of cam lug 54c, and providing a ratchet drive which permits turning of the ratchet wheel on shaft 29 in opposite directions.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of knitting machines differing from the types described above.

While the invention has been illustrated and described as embodied in an arrangement for producing a composite knitted fabric including a ribbed portion and a plain portion and having parallel lateral edges due to the provision of a smaller number of wales in the plain fabric portion than in the ribbed fabric portion, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is set forth in the appended claims:

1. A composite knitted fabric of constant width, comprising a ribbed fabric portion composed of rib stitch loop rows of equal length, each of said rows being formed of a predetermined number of rib stitch loops of predetermined size; a plain fabric portion composed of plain stitch loop rows of the same equal length as said rib stitch loop rows of said ribbed fabric portion, each of said rows formed of a number of plain stitch loops smaller than said predetermined number of rib stitch loops in each of said rib stitch loop rows, and of a size larger than said predetermined size of each of said rib stitch loops; and at least one transition row of loops between said ribbed fabric portion and said plain fabric portion having also said same equal length and including a plurality of double loops so as to reduce the number of loops from said predetermined number of rib stitch loops in said rib stitch loop rows of said ribbed fabric portion to said smaller number of plain stitch loops in said plain stitch loop rows of said plain fabric portion, whereby despite the different size and the different number of loops in said loop rows of said ribbed and plain fabric portions, the overall width of the composite fabric is maintained constant over its entire length.

2. A composite knitted fabric as claimed in claim 1

wherein said transition row includes a plurality of single loops between two double loops.

3. A composite knitted fabric as claimed in claim 1 wherein said loops of said transition row are inwardly slanted from either end of said transition row toward the center of the same.

4. A method of knitting a composite knitted fabric of constant width composed of a ribbed portion and a plain portion, comprising the steps of repeatedly knitting a predetermined number of rib stitch loops of a predetermined width to form a plurality of rib stitch loop rows of equal length; connecting to the last row of said rib stitch loop rows a transition row having a selected number of multiple loops so that said transition row is formed of a smaller number of loops than said predetermined number; knitting to each of said loops of said transition row a plain stitch loop having a width so much wider than the width of said rib stitch loops that the row of plain stitch loops which has said smaller number of plain stitch loops has the same length as said length of said rows of rib stitch loops; and knitting additional rows of plain stitch loops of said wider width to said row of plain stitch loops, said additional rows having said smaller number of loops and said length whereby the width of said plain portion is the same as the width of said ribbed portion and the width of said composite fabric is maintained constant over its entire length.

5. A method as claimed in claim 4 comprising knitting said multiple loops as double loops spaced from the ends of the last row of rib stitch loops; and knitting a plurality of single loops between said double loops of said transition row.

6. A method of knitting a fabric of constant width composed of a ribbed portion having rib stitch loops of a predetermined width, and a plain portion having plain stitch loops of a greater width than said predetermined width, comprising the steps of knitting the ribbed portion on a row of pairs of horizontal and vertical needles having a predetermined number so that rib stitch rows having a predetermined length are formed; transferring the loops of said horizontal needles to other vertical needles alternating with said first mentioned vertical needles to form a transition row; transferring at least one group of loops of said transition row in one direction from a first group of said vertical needles to a second group of said vertical needles to form a double loop; transferring in said one direction another group of loops of said transition row to a third group of said vertical needles to form another loop in said transition row; repeating the transferring of groups of loops of said transition row until a selected number of double loops and intermediate single loops is formed in said transition row whereby the number of loops in said transition row is reduced to a smaller number than said predetermined number; knitting to each of said loops of said transition row a plain stitch loop having a width so much wider than the width of the rib stitch loops of said ribbed portion that said smaller num-

ber of plain stitch loops has the same length as said predetermined length of rib stitch rows; and knitting additional rows of plain stitch loops of said wider width to said row of plain stitch loops, said additional rows having said smaller number of loops and said predetermined length whereby the width of said plain portion is the same as the width of said rib portion, and the width of said fabric is maintained constant over its entire length.

7. The method of knitting a fabric as claimed in claim 6 wherein the step of transferring said one group of loops of said transition row is effected by a group of transfer points for forming double loops; wherein said transfer points are shifted without loops a selected number of needle distances along said row of vertical needles; wherein said transfer points transfer another group of loops of the transition row to a third group of vertical needles to form new double loops; and wherein the steps of transferring groups of loops of said transition row and of shifting the transfer points without loops are repeated until the selected number of double loops is formed in said transition row.

8. The method claimed in claim 7 wherein said transfer points transfer the double loop formed during the first transfer movement of said transfer points during each consecutive transfer movement to another vertical needle.

9. The method claimed in claim 7 including moving said transfer points in one direction and for the distance between adjacent needles when transferring groups of loops of the transition row between groups of vertical needles, and shifting said transfer points without loops in the same direction a plurality of said needle distances along said row of vertical needles before transferring another group of loops of said transition row.

10. The method of claim 7 including moving said transfer points in one direction and for the distance between adjacent needles during the transfer of a group of loops of said transition row from one group of vertical needles to another group of vertical needles; and shifting said transfer points without loops in the opposite direction a plurality of said needle distances along said row of vertical needles before transferring another group of loops of said transition row.

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MERVIN STEIN, *Primary Examiner*.

R. FELDBAUM, *Assistant Examiner*.