United States Patent

Blood et al.

[15] **3,641,789**

[45] **Feb. 15, 1972**

[54] STRAIGHT BAR KNITTING MACHINES

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[73] Assignee: **William Cotton Limited**

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[21] Appl. No.: **829,561**

[30] **Foreign Application Priority Data**

June 6, 1968 Great Britain 26,903/68

[52] **U.S. Cl.** **66/96,** 66/89

[51] **Int. Cl.** **D04b 15/09**

[58] **Field of Search** 66/82–96

[56] **References Cited**

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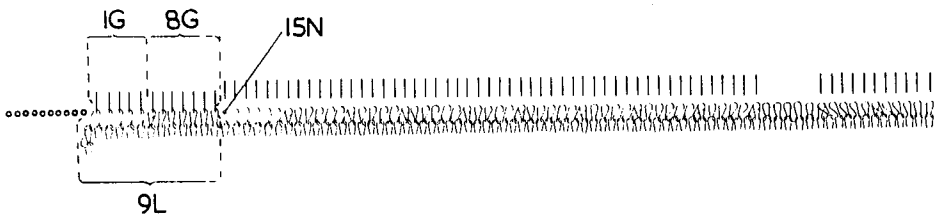
Primary Examiner—Ronald Feldbaum

Attorney—Larson, Taylor and Hinds

[57] **ABSTRACT**

Method of "loop doubling" between rib and plain knitted fabric, consisting in simultaneously transferring spaced groups of loops to form a limited number of the "loop doublings" gaps between spaced groups of loops simultaneously followed by forming a remaining required number of "loop doublings" between the simultaneously formed "loop doublings" and closing the gaps, in successive manner, and a machine for the method comprising a row of sliders for controlling loop transfer points, cam-operated control bars for rendering groups of the sliders operative and inoperative, and a cam-operated stepped bar for dividing the sliders into required groups.

12 Claims, 23 Drawing Figures



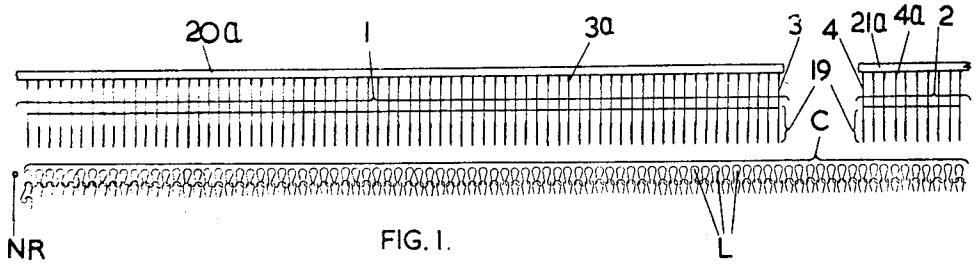


FIG. 1.

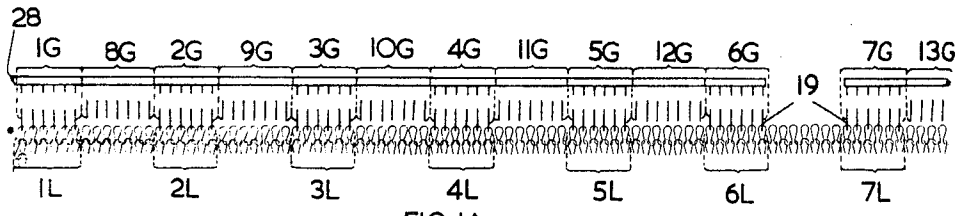


FIG. 1A.

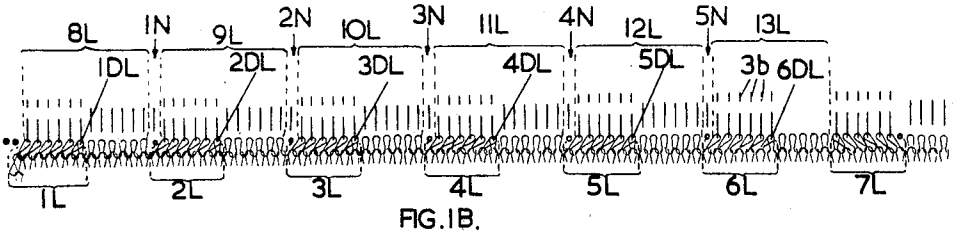


FIG. 1B.

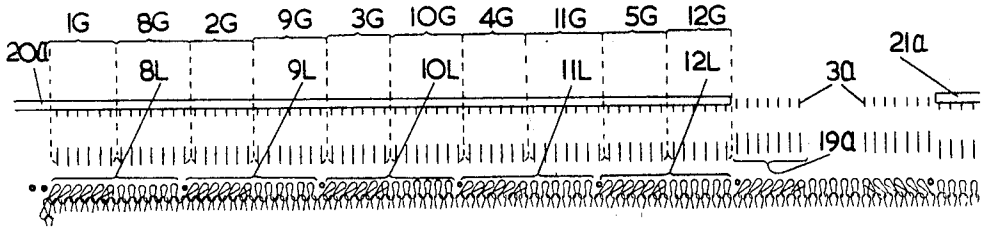


FIG. 1C.

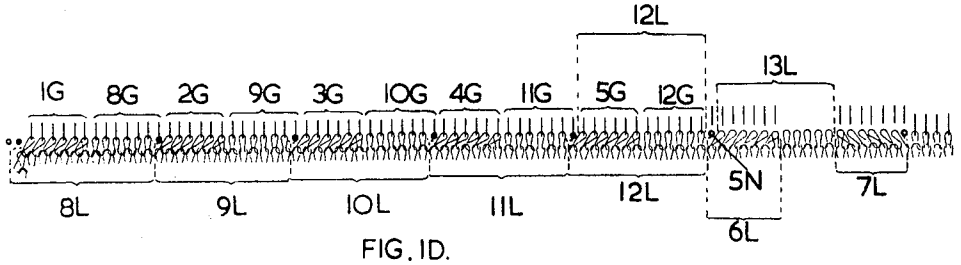


FIG. 1D.

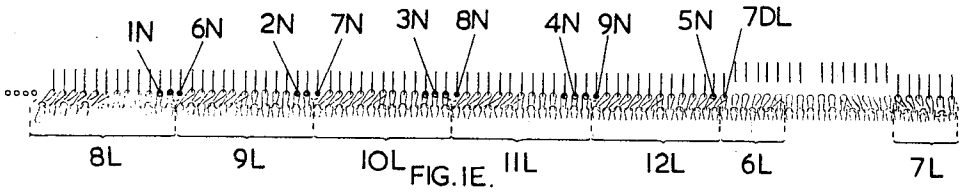


FIG. 1E.

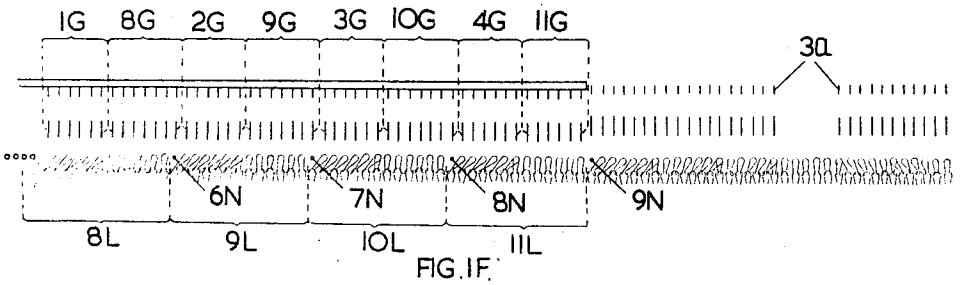


FIG. 1F.

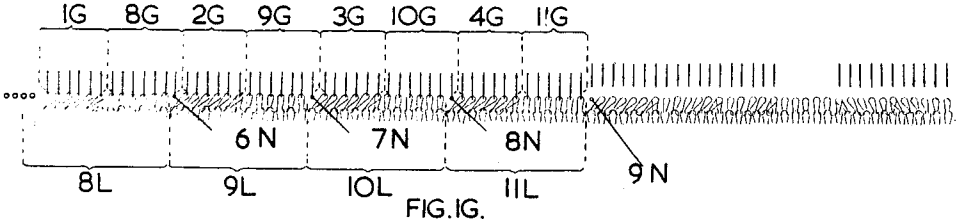


FIG. 1G.

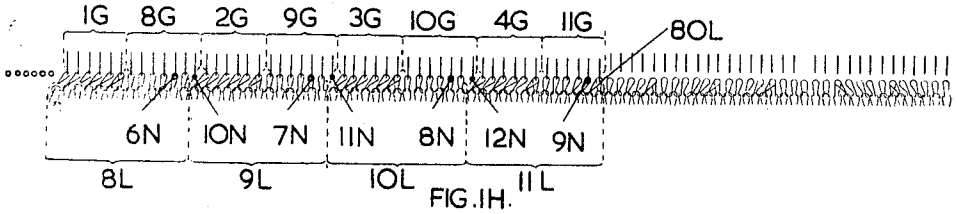


FIG. 1H.

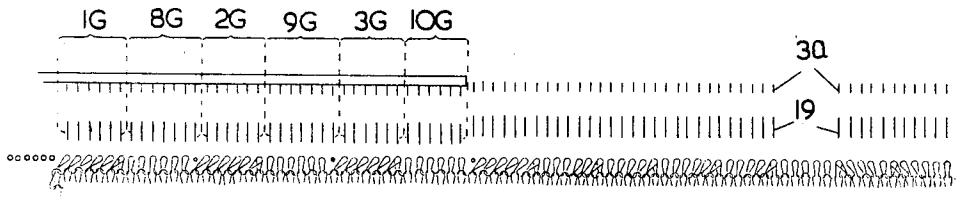


FIG. 11.

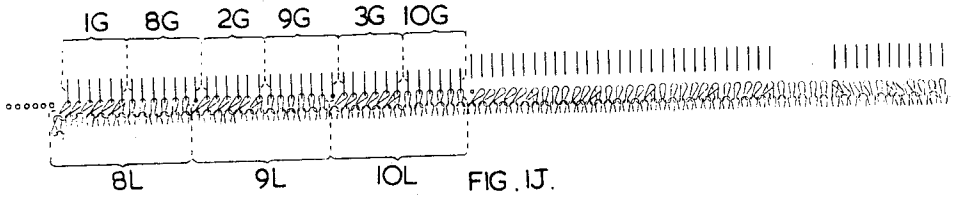


FIG. 1J.

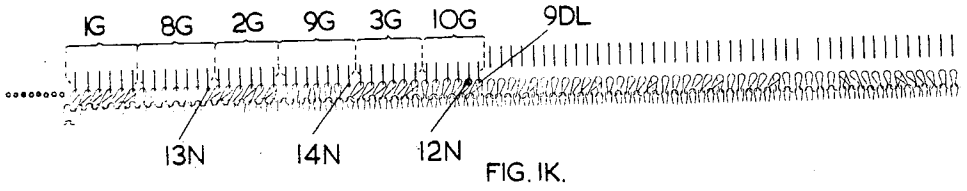


FIG. 1K.

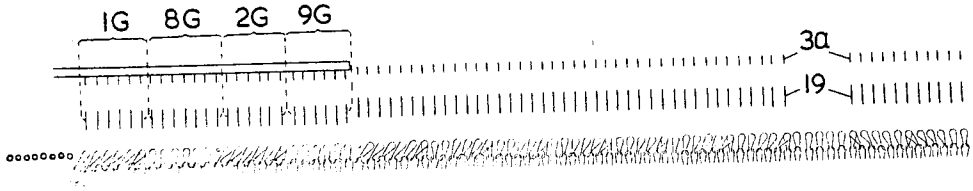


FIG. 1L.

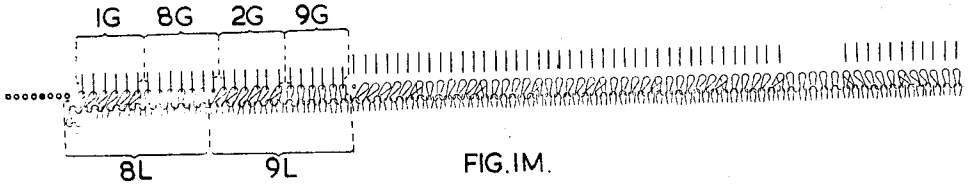


FIG. 1M.

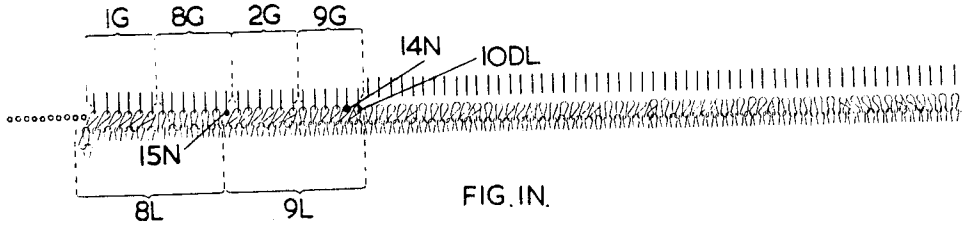


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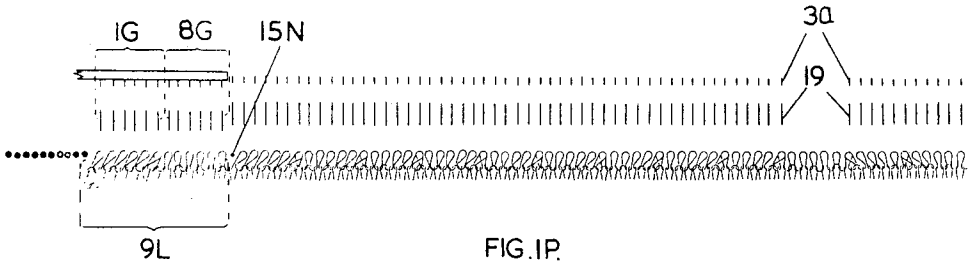


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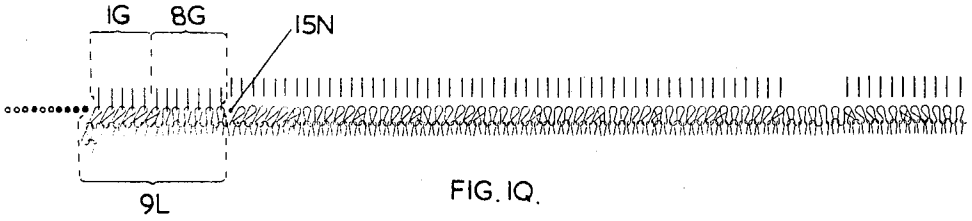


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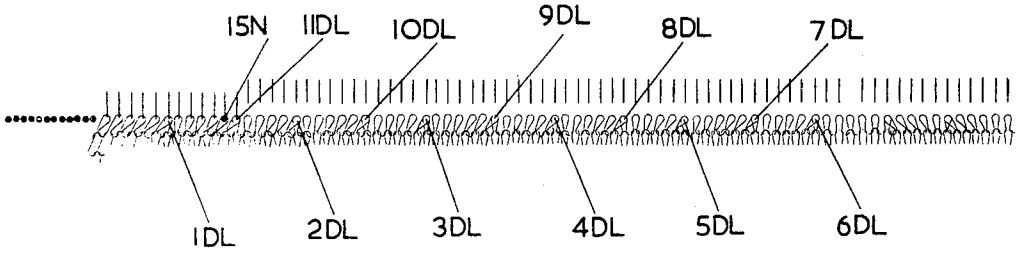


FIG. 1R.

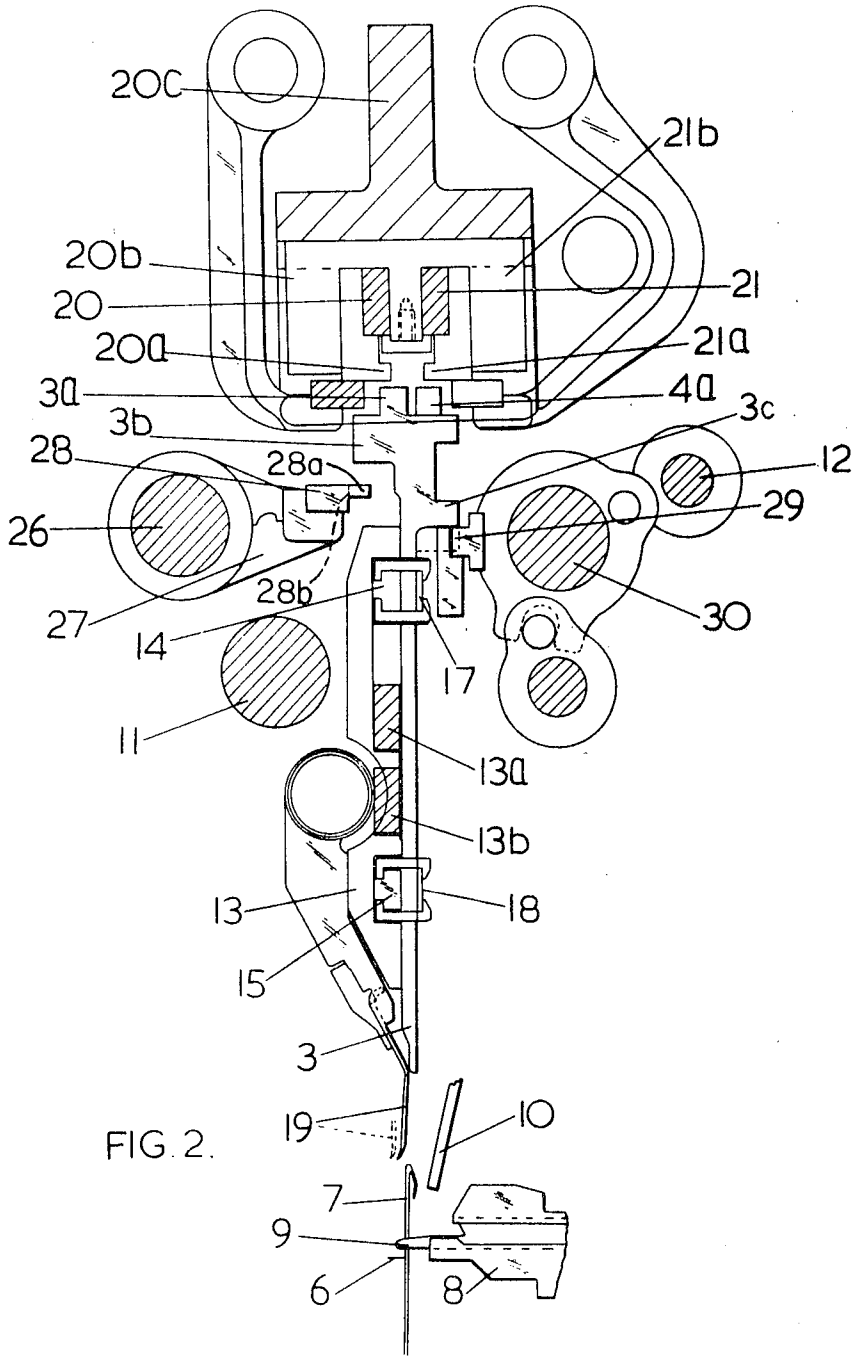

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FIG. 2.

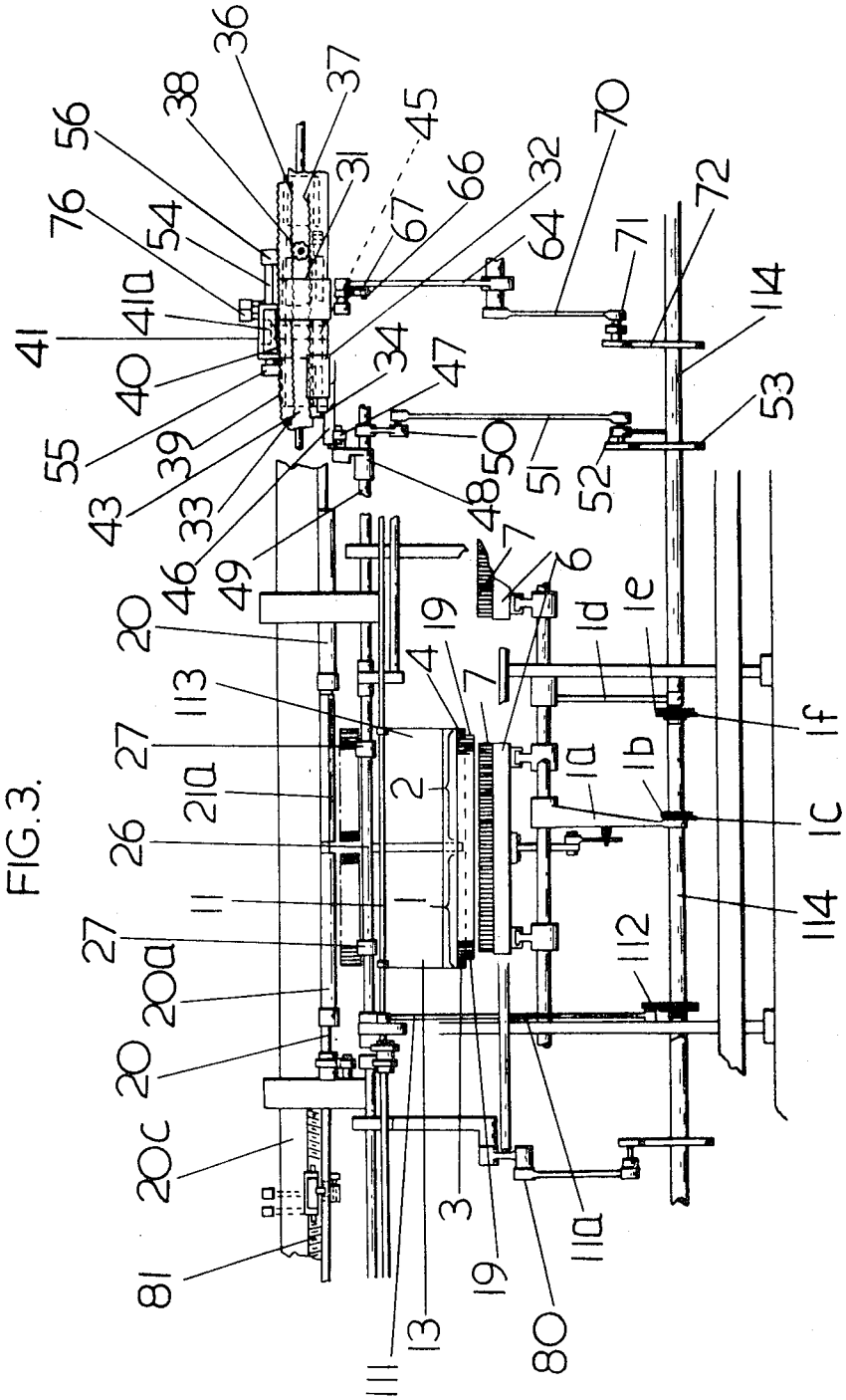

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FIG. 3.

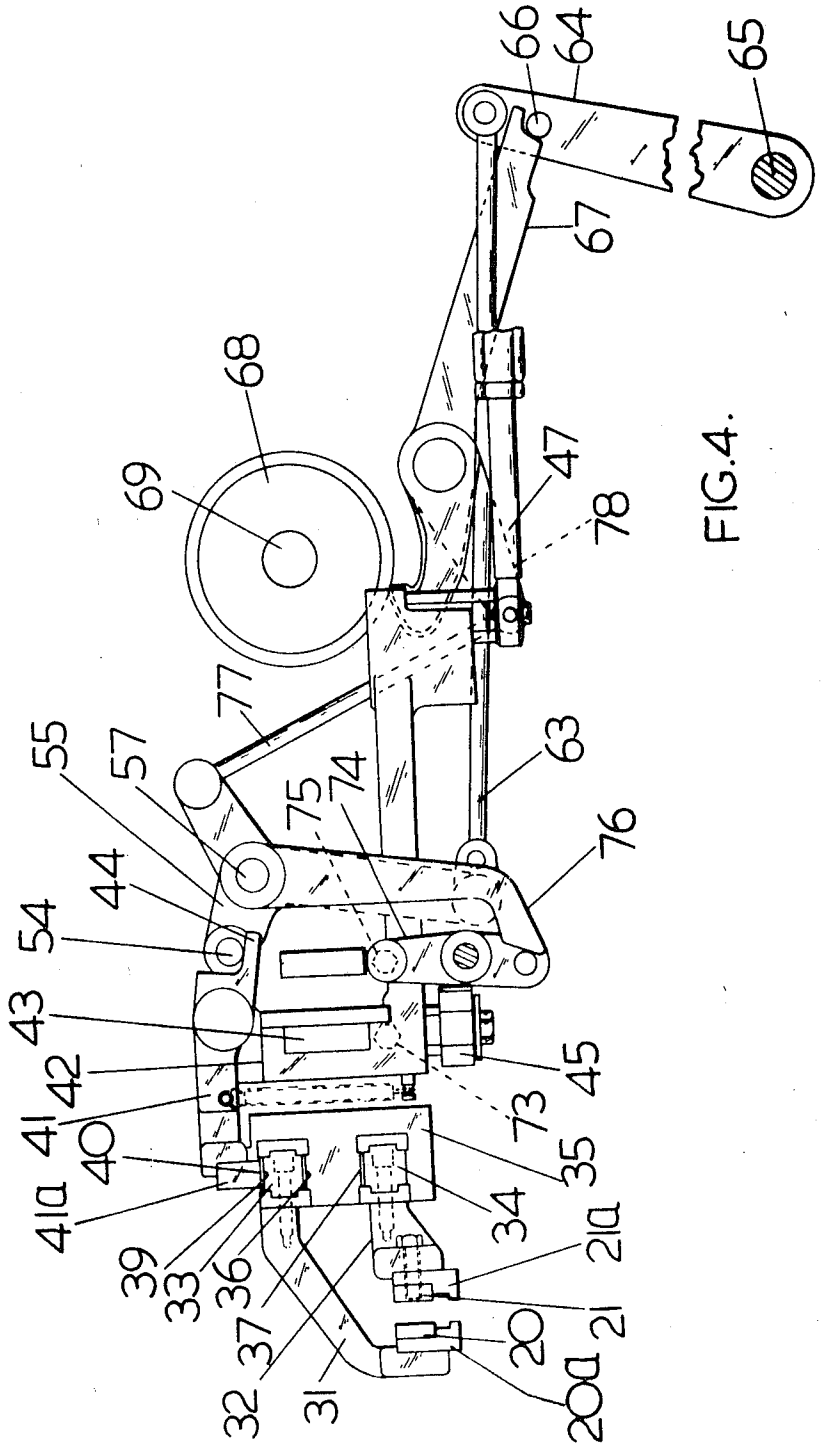
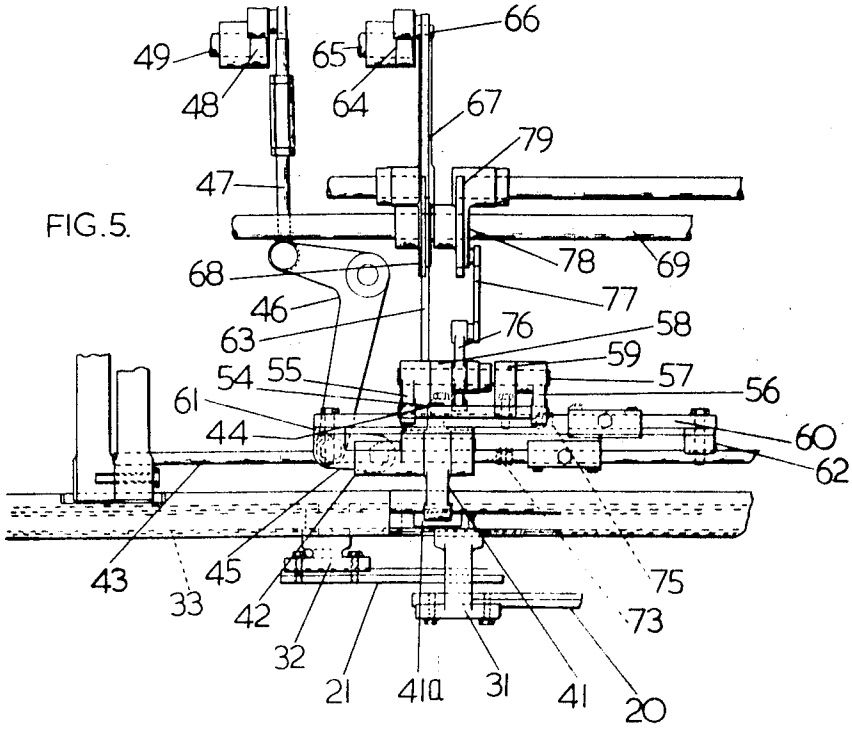

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FIG.4.

FIG. 5.


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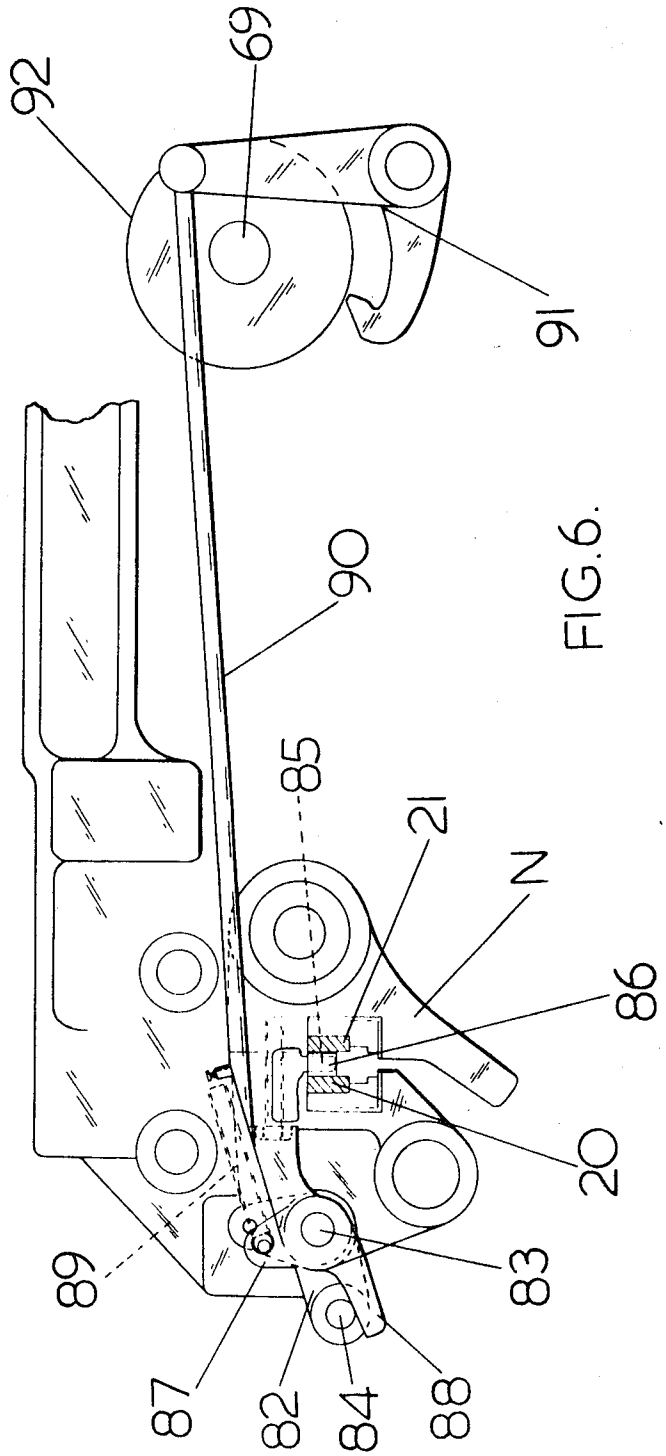


FIG. 6.

STRAIGHT BAR KNITTING MACHINES

CROSS-REFERENCES TO RELATED APPLICATIONS

Reference is made to British Pat. application Ser. No. 26903/68 of June 6, 1968, William Cotton Limited, from which priority is claimed.

This invention is for improvements in or relating to straight bar knitting machines and concerns loop doubling. Our G.B. Pat. No. 1,121,142 and U.S. Pat. No. 3,398,554 provides for loop doubling by the use of two half sets of individually slidable transfer point control elements having butts and movable with a narrowing head, the butts being under control of two control bars which are sideways displaced to provide first for outer or inner groups of loops to be transferred for a first loop doubling, then for these groups together with next adjacent groups of loops to be transferred for a second loop doubling, and so on.

The displacements of the control bars is effected through the medium of adjustable lead screws and to provide for loop doubling at any required spacing it has been proposed to provide for the adjustable lead screws being under operative control of infinitely variable selection control means such, for example, as presettable counter means.

While these arrangements are satisfactory in certain instances, in other instances they unduly limit production time since each pair of loop doublings, of which there may be say 11 or more pairs, requires a transfer operation of the machine so that there would be say 11 transfer operations of the machine without knitting any fabric.

An object of the invention is to provide for loop doubling in a comparatively small number of operations.

The invention provides a method of loop doubling which consists in a first operation of simultaneously transferring a plurality of spaced loops in a row of loops to form spaced doubled loops in spaced groups of loops, and thereafter successively transferring a different selected number of the spaced groups of loops so as to progressively close up these groups of loops. Conveniently the first operation may be by operation of spaced loop spreader elements in a previously proposed manner. Alternatively the method consists in a first operation of simultaneously transferring a plurality of small groups of loops at spaced locations in a row of the loops so as to form doubled loops and also to form spaced larger size groups of loops containing the doubled loops respectively, and successively transferring a different selected number of the spaced larger size groups of the loops so as to progressively close up the adjacent spaced larger size groups of loops and so as to form doubled loops of the adjacent loops of these larger size groups of loops. Conveniently first small groups of equal numbers of the loops at spaced locations in opposite halves of the row of loops are transferred inwardly one needle distance, and thereafter a progressively less number of the spaced larger size groups of the loops are transferred inwardly for two needle distances. Conveniently also the small groups of loops are equally spaced so that the first transfer causes doubled loops to be formed of the central loops of the spaced larger size groups of the loops.

Means for carrying out the above method in a straight bar knitting machine having a narrowing head adapted by the use of an associated row of loop transfer points for effecting loop transference, comprises a row of individually operable transfer point selection control elements, a stepped control bar for control of the selection control elements to cause spaced small groups thereof only to be disposed in the operative position required for the simultaneous formation of a plurality of loop doublings and of the spaced large size groups of loops, and further control bar means for control of the selection control elements and longitudinal displacements thereof for displacing a progressively less number of the transfer points into the operative position required for transferring to close up the spaced large groups of the loops and for the individual formations of remaining required loop doublings.

In a particular arrangement of the machine, the selection control elements are sliders carried frictionally by the narrowing head and having upper butts for engagement with the control bars of which there are two main control bars displaceable in opposite longitudinal directions for cooperation with butts on two halves respectively of the selection control elements, and a single stepped control bar for cooperation with additional butts on all the selection control elements. Conveniently the main control bars are disposed above their cooperating butts on the selection control elements so as to be effective on the butts and their selection control elements during upward movement of the narrowing head to render all the selection control elements, with which the butts engage, effective for transferring operations of their associated points, and the stepped control bar is conveniently disposed under its associated butts for cooperation therewith during downward movements of the narrowing head whereby only spaced small groups of the selection control elements remain in the effective position for loop transference of their associated points. For this operation of the stepped control bar it is adapted to have an upward movement to cooperate with the associated butts and to have a downward movement when not required to cooperate with its associated butts.

The main control bars are conveniently under longitudinally displaceable control of lead screw mechanism and presettable counter means.

Conveniently also the selection control elements may be used for fashioning substantially as disclosed in said patent, and to allow for this, the main control bars are adapted to be releasably coupled alternatively to control mechanism for the loop doubling and control mechanism for the fashioning.

The above and other features of the invention set out in the appended claims are incorporated in the construction which will now be described, as a specific embodiment with reference to the accompanying drawings in which:

FIG. 1 is a diagrammatic illustration of a transitional course of knitted loops in which change is made between rib and non-rib fabric, with loop transfer points and selector elements therefor, at the start of loop doubling.

FIG. 1A is a similar view to FIG. 1 at a stage of dividing said elements and points into small groups which are alternatively effective and boxing with their needles and noneffective for loop transference.

FIG. 1B is a similar view to FIG. 1A at a stage of loop transference by said effective groups of points.

FIG. 1C is a similar view to FIG. 1B at a stage of reselecting said elements and points for a very large group to be effective and a remaining very small group to be ineffective.

FIG. 1D is a similar view to FIG. 1C at a stage of said very large group of points boxing with their needles.

FIG. 1E is a similar view to FIG. 1D at a stage of said very large group of points transferring their loops.

FIG. 1F is a similar view to FIG. 1E at a stage of reselecting said elements and points for a large group to be effective and a small group to be ineffective.

FIG. 1G is a similar view to FIG. 1F at a stage of said large group of points boxing with their needles.

FIG. 1H is a similar view of FIG. 1G at a stage of said large group of points transferring their loops.

FIG. 1I is a similar view to FIG. 1H at a stage of reselecting said elements and points for a medium size group to be effective and a medium size group to be ineffective.

FIG. 1J is a similar view to FIG. 1I at a stage of said medium size group of points transferring their loops.

FIG. 1K is a similar view to FIG. 1J at a stage of said medium size group of points transferring their loops.

FIG. 1L is a similar view to FIG. 1K at a stage of reselecting said elements and points for a smaller group to be effective and a larger group to be ineffective.

FIG. 1M is a similar view to FIG. 1L at a stage of said smaller group of points transferring their loops. FIG. 1N is a similar view to FIG. 1M at a stage of said smaller group of points transferring their loops.

FIG. 1P is a similar view of FIG. 1N at a stage of reselecting said elements and points for a small group to be effective and a large group to be ineffective.

FIG. 1Q is a similar view of FIG. 1P at a stage of said small group of points boxing with their needles.

FIG. 1R is a similar view of FIG. 1Q at a stage of said small group of points transferring their loops.

FIG. 2 is a cross-sectional view of part of a straight bar knitting machine having loop-doubling mechanism according to the invention.

FIG. 3 is a general front view of relevant parts of the machine.

FIG. 4 is a detail view of releasable coupling means for the loop-doubling mechanism.

FIG. 5 is a detail plan view of control means for the loop-doubling mechanism.

FIG. 6 is a detail view of releasable coupling means for fashioning mechanism.

Referring to FIG. 1, this represents an initial stage in the operation of "loop doubling" in a transitional course C of knitted loops L which will occur between a rib-knitted fabric border and knitted body fabric formed on a row of needles NR in a straight bar knitting machine. For effecting the loop doubling there are provided two spaced rows, represented at 1, 2, of loop transfer points 19 in the usual narrowing head of the machine. In a manner and by means hereinafter fully described, the points 19 are deflectable between attitudes in which, when the narrowing head is operated as well known in fashioning, the points 19 can be in preselected operative and inoperative attitudes in relation to the needles and in respect of transferring needle loops from some needles to other needles.

In the initial stage of FIG. 1, the narrowing head is in a known raised position and all the points 19 are in their operative attitude.

It is here explained that, except for different selections of the points 19, they are operated by the narrowing head in the manner well known for fashioning, i.e., the narrowing head, starting at a raised position, carries the points 13 first downwards for selected points 19 to box with their associated needles NR, next upwards to take loops from the needles NR, then sideways one or two, needle distances, then downwards to box with their newly associated needles NR, and finally upwards to the starting position. For the sake of economy in drawing, FIGS. 1 to 1R do not include the usual step of actually picking up loops and actually shifting them sideways but these steps will be obvious from the description and in view of known fashioning technique.

It is also explained that the ensuing description of FIGS. 1 to 1R mainly concerns the left-hand half of the rows of needles NR, loops L, and points 19, and that it applies equally well to the right-hand half, which is only partly represented in the drawings, in mirror image of the left-hand half.

Following the stage of FIG. 1 the points 19 are selected into groups 1G to 6G and 7G, FIG. 1A, which are in their operative attitude while the intervening groups 8G to 12G and 13G are in their inoperative attitude. In FIG. 1A the narrowing head has been lowered so that the selected operative groups 1G to 6G and 7G of the points 19 box with their associated needles NR while the intervening groups 8G to 12G and 13G of the points remain clear of the needles, as indicated. As in fashioning, the narrowing head next rises for the groups 1G and 7G of operative points to pick up the groups 1L to 6L and 7L of the loops from their associated needles NR, and then the narrowing head moves sideways, in this instance one needle distance.

Following this the narrowing head dips so that the groups 1G to 6G and 7G of operative points 19 box with their newly associated needle NR, FIG. 1B, to place on them the picked-up loops 1L to 6L and 7L. In this manner the right-hand loop of each group 1L to 6L of the loops is doubled with its next adjacent loop to the right in the intervening groups 8G to 12G and in mirror image the left-hand loop of the group 7L of the loops, for example, is doubled with its next adjacent loop to the left. Thus there is formed left and right series, in this example six each, of required double loops 1DL to 6DL and, for example, 7DL, simultaneously. This leaves, for example, in the left-hand half, five spaced needles, 1N to 5N which are devoid of loops and this divides the loops into separated larger groups 8L to 13L each having a middle double loop as shown and spaced by one loop distance gap.

Referring to FIG. 1C, this represents a next selection stage whereat the points of a very large group 1G to 5G and 8G to 12G of the points 19, which extend from the left-hand selvedge to the right-hand empty needle 5N, are selected to be in their operative altitude, as shown to the left of the Figure, while the points 19*a* of the remaining very small group of the points are in their inoperative altitude as shown towards the right of the Figure.

FIG. 1D shows the next dipping stage of the narrowing head for the operative points 1G to 5G and 8G to 12G to box with their associated needles which includes the needle next adjacent to the left of the empty needle 5N. The narrowing head is then operated as before but for the operative points 19 to pick up all the needle loops 8L to 12L, to sideways shift all these loops to the right, in this instance a two-needle distance, and to box with the newly associated needles as in FIG. 1E. By this means all the loops 8L to 12L have been moved two needles to the right across the gap caused by the empty needle 5N to close up this gap. This not only includes forming a further double loop 7DL, i.e., in this example, a seventh double loop, with the next loop to the right of the empty needle 5N, but it also includes providing a loop on the needle 5N. The needles 1N to 4N also receive loops but other needles 6N to 9N become devoid of loops. However the number of empty needles, or the number of gaps is thus reduced from five to four.

At a next selecting stage, FIG. 1F, the group of points 19 selected is reduced in size in relation to the last selection, FIG. 1C, to the groups 1G, to 4G and 8G to 11G, so that the right-hand end point 19 registers with the loop next adjacent to the left of the empty needle 9N. As before, the selected points 19 are operated by the narrowing head first to box with the needles. FIG. 1G, next to take off the corresponding reduced number of loops 8L to 11L from the needles, then to move to the right a two-needle distance, and then to box with the newly associated needles as indicated in FIG. 1H. By this means all the reduced number of loops 8L to 11L have been moved two needles to the right, across the gap caused by the empty needle 9N to close up their gap. This includes forming a further double loop 8DL, i.e., in this example an eighth double loop, with the next loop to the right of the needle 9N, and it also includes providing a loop on the needle 9N. The needles 6N to 8N also receive loops but other needles 10N to 12N become devoid of loops. However, the number of empty needles or gaps, is thus reduced from four to three.

This system with reference to FIGS. 1C to 1H, in which the number of points selected for operation, the number of loops transferred, and the number of empty needles, is reduced, and in which further double loops are formed single in succession, is continued in similar and progressive manner until there are no empty needles and a further required number of double loops, i.e., in this example three, have been formed. The continued operations are illustrated in FIGS. 1I to 1R, and since a number of the steps of operation are repetitive of steps already described with reference to FIGS. 1C to 1H the following description is abbreviated to avoid unnecessary tautology.

Referring to FIG. 1I this shows the next selecting stage at which a further reduced number of groups 1G to 3G and 8G to 10G of the points 19 are selected for operation. They box with their associated needles, FIG. 1J, pick up the reduced number of loops 8L to 10L, sideways displace these loops, and then box with their newly associated needles as in FIG. 1L. This forms a further or ninth double loop 9DL, provides a loop on needle 12N to close up the gap at this location, and leaves only two needles 13N, 14N devoid of loops. Similarly as in FIG. 1L, a still further reduced number of groups 1G, 2G, 8G and 9G of the points 19 are selected for operation. These points box with

their associated needles, FIG. 1M, pick up the reduced number of loops 8L, 9L, sideways displace these loops, and then box with their newly associated needles as in FIG. 1N. This forms still further or 10th double loop 10DL, provides a loop on needle 14N to close up the gap at this location, and leaves only one needle 15N devoid of a loop.

Finally as in FIG. 1P, only a small number of groups 1G, 8G of the points are selected for operation. These points box with their needles, FIG. 1Q, pick up the small number of loops 9L, sideways displace these loops, and then box with the newly associated needles as a FIG. 1R. This forms the last or 11th double loop 11DL, and provides a loop on needle 15N to close up the gap at this location, and does not leave any needle devoid of a loop. This completes the loop doubling which provides in this example 11 loop doublings 1DL–11DL in each half of the transitional course as shown in FIG. 1R for the left-hand half of this course.

Whereas in previous known arrangements 11 such loop doublings in each half of the course would require 11 loop transfer operations, in the present method providing for the same number of doublings, that is 11 in each half of the course, there are only six loop transfer operations.

It is also to be understood that the small groups of loops may be of any size required to provide for any required number of loop doublings at any required spacing.

This loop-doubling method is conveniently carried out on a straight bar knitting machine. Briefly the machine is represented in FIGS. 2, 3 by a needle bar 6 of bearded needles 7, a sinker bar 8 of sinkers 9, thread carrier means 10, and a narrowing head represented by rods 11, 12 and half-length bedplates 13, 113, FIG. 3, which are connected by a link 111 to cam-operating mechanism 112 on the machine's main camshaft 114 for producing dipping motions of the narrowing head in customary manner for loop-transferring operations to be effected.

Secured to the bedplates 13, 113 are guide bars such as 14, 15 having tricks for the half-length rows of transfer point control elements 3, 4 which are frictionally held such as by cover plates 17, 18 fitted to the guide bars 14, 15.

In the position shown the narrowing head is in an upper position with lower portions of the elements 3, 4, partly projecting downwardly and just engaging transfer points 19 which are consequently in nondeflected position not suitable for loop transfer operations when the narrowing head dips. The dotted position, FIG. 2, for the points 19 is that to which the points are deflected by lowering movements of the elements 3, 4 so that the elements can box with the needles when the narrowing head dips so that transferring takes place by the points when in the deflected position.

The upper projecting ends of the elements 3, 4 have butts 3*a*, 4*a*, at different positions for the respective halves of the row thereof, and all have lateral butts 3*b*.

Above the narrowing head are mounted spaced bars 20, 21 equivalent to the rods 44, 45 in said patent, and having on their inner sides control bars 20*a*, 21*a*, FIGS. 2, 3, disposed respectively over the butts 3*a*, 4*a*.

The bars 20, 21 are slidably mounted in tracks 20*b*, 21*b*, and the whole assembly is carried by a 'T' sectioned rail 20*c*, extending the full length of the machine.

On an oscillatable spindle 26 are arms such as 27 carrying a bar 28 for cooperation with the butts such as 3*b* on the elements 3, 4. The bar 28 is formed with projections 28*a* spaced by recesses 26*b*. The projections and recesses are of substantially equal length longitudinally of the bar 28 to suit the spacing of the loop doubling required, for example, the length of each projection and of each recess is equivalent to six needle distances for loop doublings on every sixth needle.

For sideways displacements of the bedplates such as 13, one is secured to a bar 13*a*, and the other is secured to a bar 13*b*.

The elements 3, 4 also have butts such as 3*c* for cooperation with bars 29 carried by a rocking unit 30 on the shaft 12.

In operation of the machine for loop doubling by the method of FIGS. 1 to 1R, the first stage, FIG. 1, is provided for by the bars 20*a*, 21*a* being in inward positions but spaced as shown for a distance equivalent to in this example seven needle distances so that the elements 3, 4 are disposed opposite all the needle loops 5 except a central group of six. The narrowing head, in a raising movement, carries the elements 3, 4 to move their butts 3*a*, 4*a* into engagement with the bars 20*a*, 21*a* whereby all the elements 3, 4 are in the operative down position.

Then the narrowing head lowers, the stepped bar 28, is raised so that the small groups 1G to 6G, and such as 7G, of the elements 3, 4 are allowed by the recesses 28*b* in the stepped bar 28 to remain in the operative down position while the intermediate small groups 8G to 12G, and such as 13G of the elements 3, 4 are held by the projections 28*a* of the stepped bar 28 and the butts 3*b* in an upper position. As the narrowing head continues lowering, the groups of operative elements 3, 4 deflect their transfer points 19 to the dotted position, FIG. 2, in which they are effective and box with their needles; FIG. 1A. Then the narrowing head rises for the points to take spaced groups of loops off their needles. The bars 13*a*, 13*b*, FIG. 2, are then given an endwise movement toward each other, each one needle distance, and the narrowing head again lowers for the groups of effective points to transfer the small groups of loops 1L to 6L, FIG. 1B, onto the needles next adjacent to those from which the loops had been taken. Thus the six loop doublings 1DL to 6DL and the gaps caused by empty needles 1N to 5N, and of course six further loop doublings and gaps by operation of the groups such as 7G of the elements 4, are formed as hereinbefore described. Prior to the narrowing head next rising, the bar 29, FIG. 2, is raised to return all operative elements 1G to 7G to upper inoperative position, and the bars 20*a*, 21*a* are outwardly displaced each for a distance, in this example, of seven needles, so that upon a further raising of the narrowing head, FIG. 1C, all elements 3, 4 except the groups 6G, 7G are lowered, and the stepped bar 28 is lowered and remains thereafter in this inoperative position. Therefore in the next complete operation of the narrowing head, FIGS. 1D, 1E, including inwards displacements of the bars 20*a*, 21*a* each two needle distances, all the loops except the groups 6L, 7L are inwardly transferred two needle distances which forms the doubled loop 7DL and closes the gap of needle 5N and likewise with their counterparts.

These operations are repeated, FIGS. 1F to 1R, each time displacing the bars 20*a*, 21*a* outwardly each for a distance, in this example of seven needles, and at the appropriate time displacing the bars inwardly two needle distances for forming the remaining doubled loops 8DL to 11DL in the manner hereinbefore described.

It will be understood that the rod 26 and rocking unit 30 can be operated by any convenient means such, for example, as cam-operated means. The endwise adjusting movements of the bars 20, 21 may be by counter-controlled lead screw means, whereby the spacing of the loop doublings may be readily changed to suit requirements, it being understood that any such change will be accompanied by changing of the stepped bar 28 having its projections and recesses of a length to suit the different spacing of loop doublings required.

In one arrangement FIGS. 3, 4 the control bars 20, 21 are connected, for their endwise adjustment, by arms 31, 32 to rack bars 33, 34 slidable in support means 35. These rack bars 33, 34 have opposed gear teeth 36, 37 which are interconnected by a pinion 38, and the top edge of the upper rack bar 33 is formed with rack teeth 39. Engaging with these rack teeth are rack teeth 40 on the underside of one end 41*a* of a rack arm 41 which is pivotally mounted in a slide block 42 on a fixed guide rail 43 and has a tail part 44. The slide block 42 is connected by a link 45 FIG. 5 to a bellcrank lever 46 which is connected by a link 47 to an arm 48 on a spindle 49. The spindle 49 is connected by an arm 50 FIG. 3 and a link 51 to cam follower means 52 engaging a cam 53 on the machine's main camshaft 114.

The rack arm's tail part 44 underlies a rod 54 carried by spaced levers 55, 56 pivoted on a rod 57 FIG. 5 carried by

brackets **58**, **59** secured to a short rail **60** which is secured by brackets **61**, **62** to the rail **43**.

The lever **55** has connected to its lower end a link **63**, FIG. **4** which is connected to an arm **64** on a pivot **65**, and the arm **64** has a peg **66** which is releasably engageable by a prop lever **67** under control of a control disc **68** on the machine's top disc control shaft **69**. The arm **64** is connected by connections **70**, FIG. **3** to cam follower means **71** operable by a cam **72** on the main camshaft **114**.

The cams **53** and **72** are arranged so that, with the prop lever **67** disengaged for each outward adjustment when required, the cam **53** causes small displacements of the rack bars **33**, **34**, and consequently displaces the bars **20**, **21**, in the required outwards direction for the control bars **20***a*, **21***a* and during this time the rack lever **41** is held in engagement with the rack bar **33** by the cam **72** until the end of the movement, and the tail **44** of lever **41** rides under the rod **54** to one end thereof. At this stage, the cam **72** rocks the levers **55**, **56** which then rocks the lever **41** to disengage the rack end **41***a* from the rack **33**. Then cam **53** reverses the direction of the rack lever **41** without moving the rack bars **33**, **34** back thereby to reset ready for the next small displacements of the bars **20**, **21** in the same required outwards direction for the control bars **20***a*, **21***a* as before and so on to displace the rack bars an additional small distance each time. Thus it will be seen how the control bars **20***a*, **21***a* obtain their progressive outward adjustments.

An adjustable limit stop **73** FIG. **5** ensures accuracy in the extent of the displacements which are constant except for the first displacement between the stages **1S** and **1TS** FIG. **1** where the displacement is half that of the subsequent displacements. For this first stage there is a spacer lever **74** FIG. **4** which is adapted to be removably positioned to cooperate with an adjustable stop **75** to limit the displacement with accuracy, and the spacer lever **74** is under control of a lever **76** connected by a link **77** to a control lever **78** operable by a control disc **79** on the top disc shaft **69**.

For raising and lowering operation of the stepped bar **28** and of the bar **29**, the shafts **26**, **30** are rocked through the medium of cam-operated mechanism such as **80**, FIG. **3**, under control of control means such as hereinbefore referred to with reference to the top disc control shaft **69** and control discs **68**, **79**.

Provision is made for the same control bars **20***a*, **21**to be alternatively employed for fashioning control when required. For this purpose the rack lever **41** is raised out of operation under control of the disc cam **68**, and the bars are then coupled to usual fashioning lead screw mechanism indicated at **81** in FIG. **3**. The coupling means comprises a pair of spaced coupling levers such as **82**, FIG. **6**, pivoted at **83** to usual screwnuts 'N' of the fashioning lead screw mechanism and having lateral rods such as **84** at one end and depending pegs such as **85** at the other end adapted for releasable engagement between spaced lugs such as **86** on the respective adjustment bars **20**, **21**. For displacing the levers such as **82**, control levers such as **87** have tail portions such as **88** underlying the lateral rods **84**, and the control levers are biased by springs **89** and are operable through a link connection **90** to a control lever **91** operable by a control disc **92** on the disc shaft **69**. The coupling levers **82** are thus adapted for coupling the adjustment bars **20**, **21** to the fashioning lead screw mechanism for use when required for fashioning.

What we claim is:

1. A method of producing knitted fabric in which between a length of rib-knitted fabric and a length of nonrib-knitted fabric is a coursewise extending series of required spaced doubled loops, the operation of forming a transitional course of knitted loops at the last knitted end of the rib-knitted fabric, a first loop transfer step of forming a predetermined number of said doubled loops simultaneously by transferring predetermined spaced small groups of loops simultaneously for a one-loop distance in a common direction which forms said doubled loops in the middle of separated layer groups of loops which are spaced by one-loop distance gaps, a second loop transfer step of transferring all said larger groups of loops at one side of one end gap for a two-loop distance across said one end gap to close up said one end gap and provide a further doubled loop midway between the adjacent end two of said simultaneously formed doubled loops, and repeating said second loop transfer step on the remaining separate large groups of loops which become progressively fewer so as to progressively close up the remaining gaps and form further doubled loops until the required number thereof is completed and there are no gaps.

2. In a method of producing knitted fabric in which between a length of rib-knitted fabric and a length of nonrib-knitted fabric is a coursewise extending series of required spaced doubled loops, the operation of forming a transitional course of knitted loops at the last knitted end of the rib-knitted fabric, a first loop transfer step of simultaneously transferring spaced small groups of said knitted loops one needle distance inwardly of the length of the course for the innermost loops of each said groups of loops to simultaneously form with inwardly adjacent loops alternate ones of said required doubled loops in the middle of separated larger groups of loops which are spaced by single empty needles, a second loop transfer step of transferring all said larger groups of loops at the outer sides of the two innermost empty needles for a two-needle distance to close up the two innermost large groups of loops inwardly and provide a loop on each of the two innermost empty needles and a further doubled loop on each of the two next inner needles which reduces the number of said separated large groups of loops by two, and repeating said second loop transfer step on the remaining large groups of loops which become progressively reduced in number so as to progressively close up such large groups of loops inwardly and provide loops on the empty needles and form doubled loops until the required number of the other alternate ones of said required doubled loop has been completed and there are no empty needles.

3. In a method of producing knitted fabric in which between a length of rib-knitted fabric and a length of nonrib-knitted fabric is a coursewise extending series of required spaced doubling loops, the operation of forming a transitional course of knitted loops at the last knitted end of the rib-knitted fabric, a first loop transfer step of transferring a predetermined number of spaced small groups of said knitted loops one needle distance in a common direction lengthwise of the course for the loops at the same ends of each said groups of loops to simultaneously form with adjacent loops between said groups of loops a predetermined number of said required doubled loops in the middle of separated larger groups of loops which are spaced by single empty needles, a second loop transfer step of transferring all said groups of loops at one side of one end empty needle for a two-needle distance towards said one end to close up the group of loops at said one end and provide a loop on said one end empty needle and a further doubled loop on an adjacent needle which reduces the number of said separated large groups of loops by one, and repeating said second loop transfer step on the remaining separate large groups of loops which become progressively fewer so as to progressively close up such groups of loops and provide loops on the empty needles and form further doubled loops until the required number thereof has been completed and there are no empty needles.

4. A straight bar knitting machine for knitting plain and rib fabric with a transitional course of loops therebetween comprising, a row of bearded needles, a narrowing head having a row of loop transfer points operable with dips, rises, and sideways motions for cooperation between the points and the needles to effect transference of loops from some needles to adjacent needles, a row of selection control elements operably associated in said narrowing head with said points and displaceable for rendering said points effective and ineffective for transfer of loops on said needles, first control bar means having longitudinally alternating projections and recesses ex-

tending along said row of elements for operable association with said elements, means for causing said projections of said first control bar means to act on spaced groups of said elements and render spaced groups of said points ineffective while intervening groups of said points remain effective, so that operation of the narrowing head causes said intervening groups of said points to simultaneously form spaced loop doublings in spaced groups of said fabric loops, means for rendering said first control bar means inoperative, second control bar means extending along said row of elements for operable association with said elements, means for causing said second control bar means to act, while said first control bar means is inoperative, a plurality of times on progressively decreasing numbers of said elements and render their associated points effective while progressively increasing numbers of said points become ineffective, so that operation of the narrowing head causes the points to form further loop doublings successively while closing said spaced groups of loops together.

5. A machine as claimed in claim 4 having said elements in the form of vertical sliders carried frictionally by said narrowing head, said first control bar means comprising a first single control bar extending for the full length of the row of sliders, first butts on upper ends of said sliders for control by said first single control bar, said first single control bar being under said first butts for said control to be during downward movements of said narrowing head, said second control bar means comprising second and third control bars for cooperation with respective halves of said row of sliders, second and third butts on upper ends of said sliders of respective halves of said row of sliders for control by said second and third bars respectively, said second and third control bars being over said second and third butts for the latter control to be during upward movements of said narrowing head, and said means for rendering said first control bar means inoperative being adapted for moving said first single control bar downwardly.

6. A machine as claimed in claim 4 wherein said means for causing said second control bar means to act on progressively decreasing numbers of said elements comprises lead screw mechanism operably connected to said second control bar means, and presettable counter means operably associated with said lead screw mechanism for controlling operations.

7. A machine as claimed in claim 4 having first control mechanism for controlling said second control bar means for loop doubling, second control mechanism for controlling said second control bar means for fashioning, and means for changing control between said first and second control mechanisms.

8. A machine as claimed in claim 4 wherein said second control bar means comprises two control bars, and means outwards endwise displacements of said two control bars, over respective halves of said row of elements, comprises two rack means to which said two control bars are connected, cam-operating means for causing small endwise displacements of the rack means, a rack arm connected to said cam-operating means and slidable thereby in opposite directions longitudinally of the rack bars, and cam-operating means for operable association with said rack arm and adapted to allow the rack arm's operation on said rack bars in one direction and to prevent reverse operation of the rack bars upon return of the rack arm.

9. A machine as claimed in claim 4 having means for rendering said "means for causing said second control bar to act" operative and inoperative when required.

10. A machine as claimed in claim 4 having stop means for limiting the extent of each act of said second control bar means, spacer means for cooperation with said stop means to further limit said extent, and means for moving said spacer means into and out of operation when required.

11. A machine as claimed in claim 4 having a third control bar means and cooperating butts on said elements, rocking shafts respectively mounting said first and third control bar means, and cam-operating means connected to said shafts for controlling said first and third control bar means.

12. A machine as claimed in claim 4 having first control mechanism for controlling said second control bar means for loop doubling and including a rack arm, and second control mechanism for controlling said second control bar means for fashioning and comprising pattern means for rendering said rack arm ineffective, fashioning lead screw mechanism, means for coupling said second control bar means to said fashioning lead screw mechanism, said coupling means comprising spaced coupling levers pivoted to the lead screwnuts and having releasable coupling elements for releasable connection to said second control bar means, and pattern means for controlling said coupling levers.

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