United States Patent

Betts et al.

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[54] KNITTING OF GARMENTS

[72] Inventors: **Max William Betts,** Coventry; **Frank Robinson,** Borrowash, both of England

[73] Assignee: **Courtaulds Limited,** London, England

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[30] **Foreign Application Priority Data**

Sept. 27, 1967 Great Britain 43,924/67

[52] **U.S. Cl.** **66/70,** 66/76, 66/176

[51] **Int. Cl.** **D04b 7/10**

[58] **Field of Search** 66/60, 64, 70, 76, 75, 73, 66/176

[56] **References Cited**

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3,167,938 2/1965 Seiler 66/70

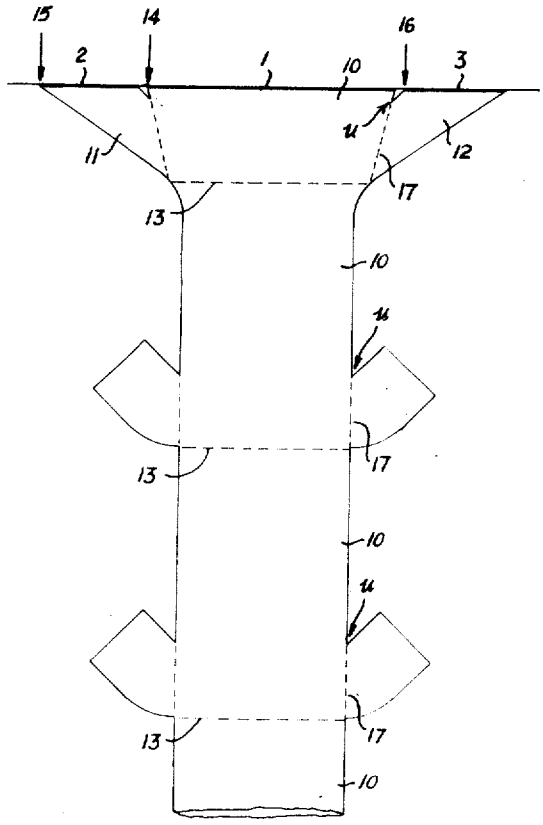
Primary Examiner—Ronald Feldbaum

Attorney—Davis, Hoxie, Faithfull & Hapgood

[57] **ABSTRACT**

A method of knitting a garment comprising knitting a first portion of the garment in the form of a tube on needles of at least two pairs of opposed beds of a machine, which pairs of beds are laterally movable with respect to one another and can overlap, widening the tubular portion by introducing needles on at least one pair of beds at a point closer to those needles of another bed carrying stitches than the needles of the said one pair of beds already carrying stitches which are most remote from the said needles of the other pair of beds, and further widening the tubular portion by introducing needles in following courses of knitting at points closer to the said needles of the other pair of beds than the needles first introduced, effecting relative lateral movement between the pairs of beds to rearrange the stitches into separate groups, one group on each pair of beds, and knitting separately on to each group of stitches to produce a further tubular portion on each pair of beds.

7 Claims, 8 Drawing Figures



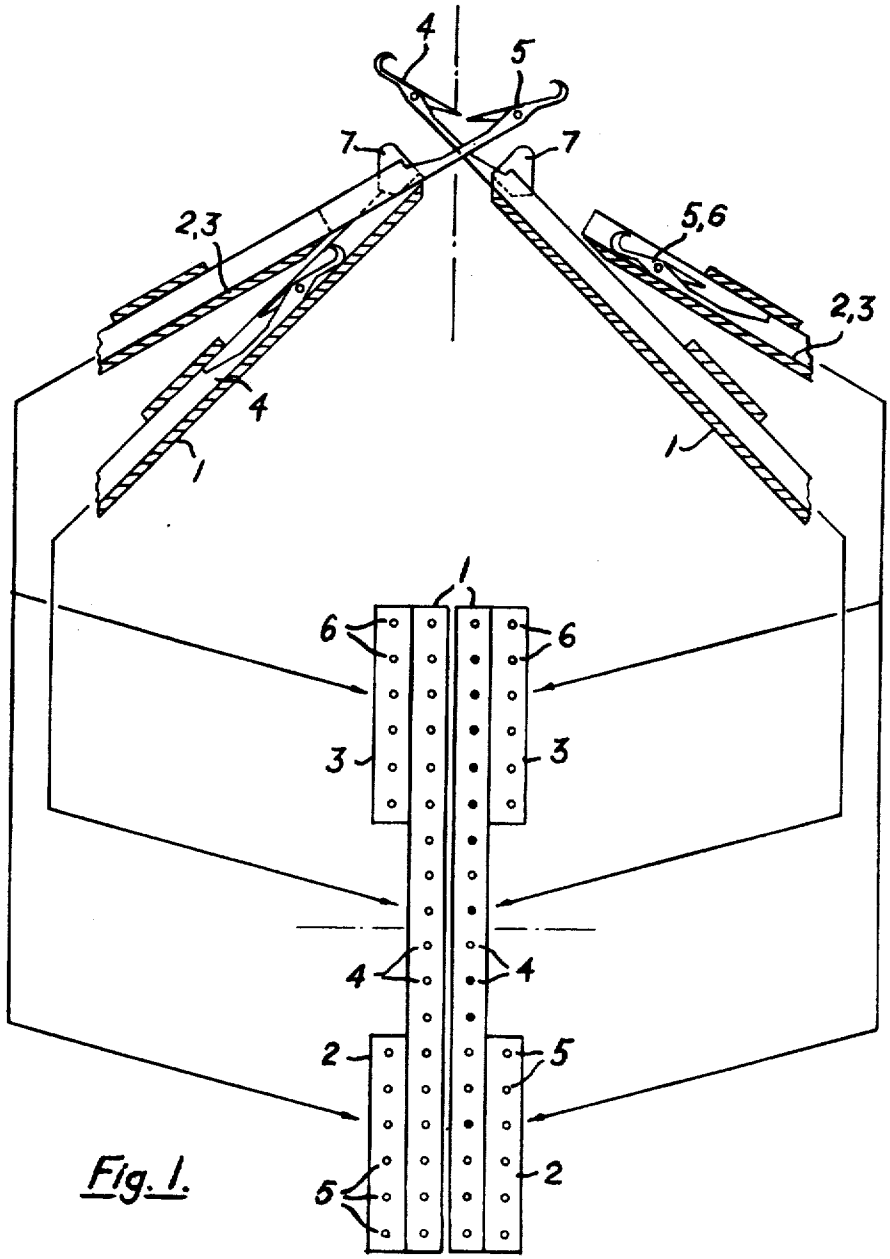


Fig. 1.

Inventor

MAX WILLIAM BETTS &
FRANK ROBINSON
By

DAVIS, HOXIE, FAITHFULL & HAPGOOD *Attorney*

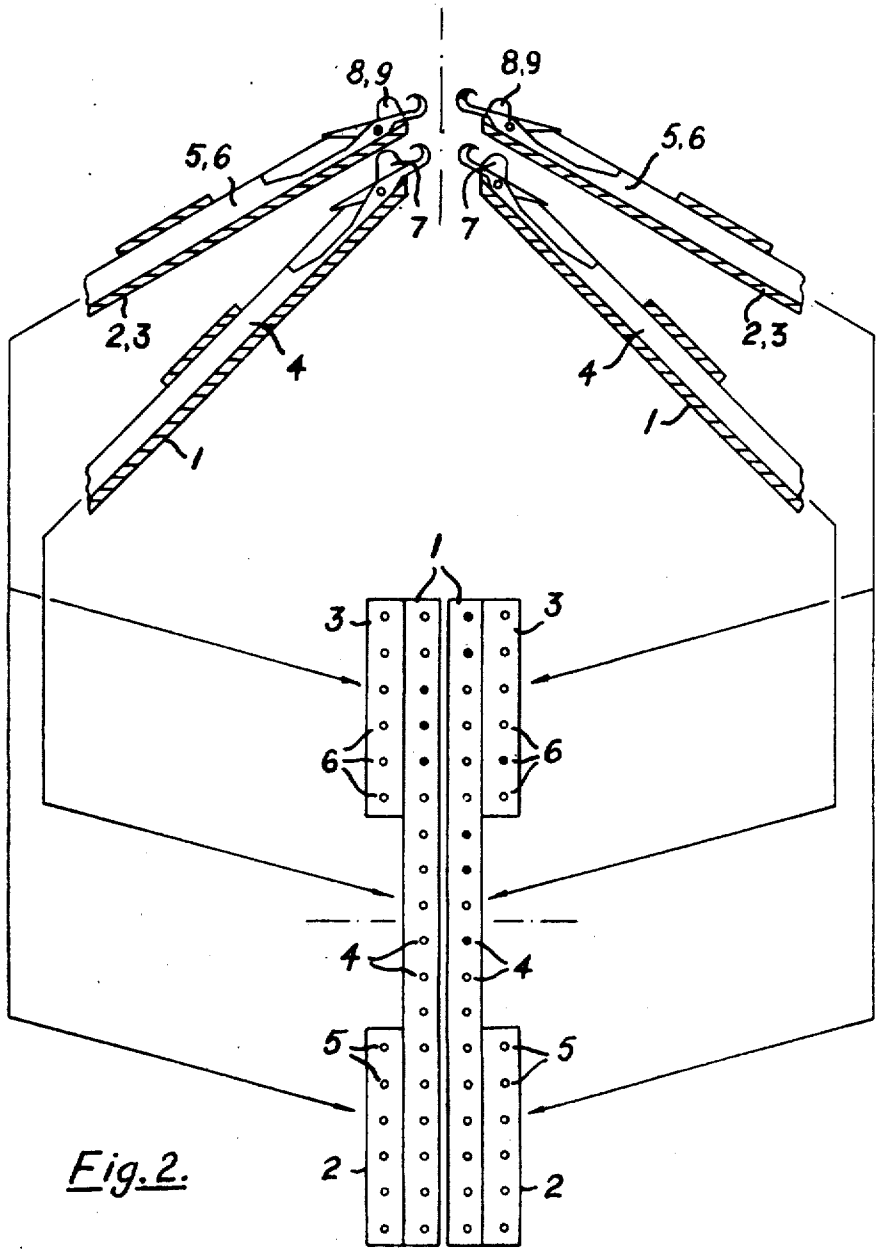


Fig. 2.

Inventor
MAX WILLIAM BETTS &
FRANK ROBINSON
By

DAVIS, HOXIE, FAITHFULL & HAPGOOD *Attorney*

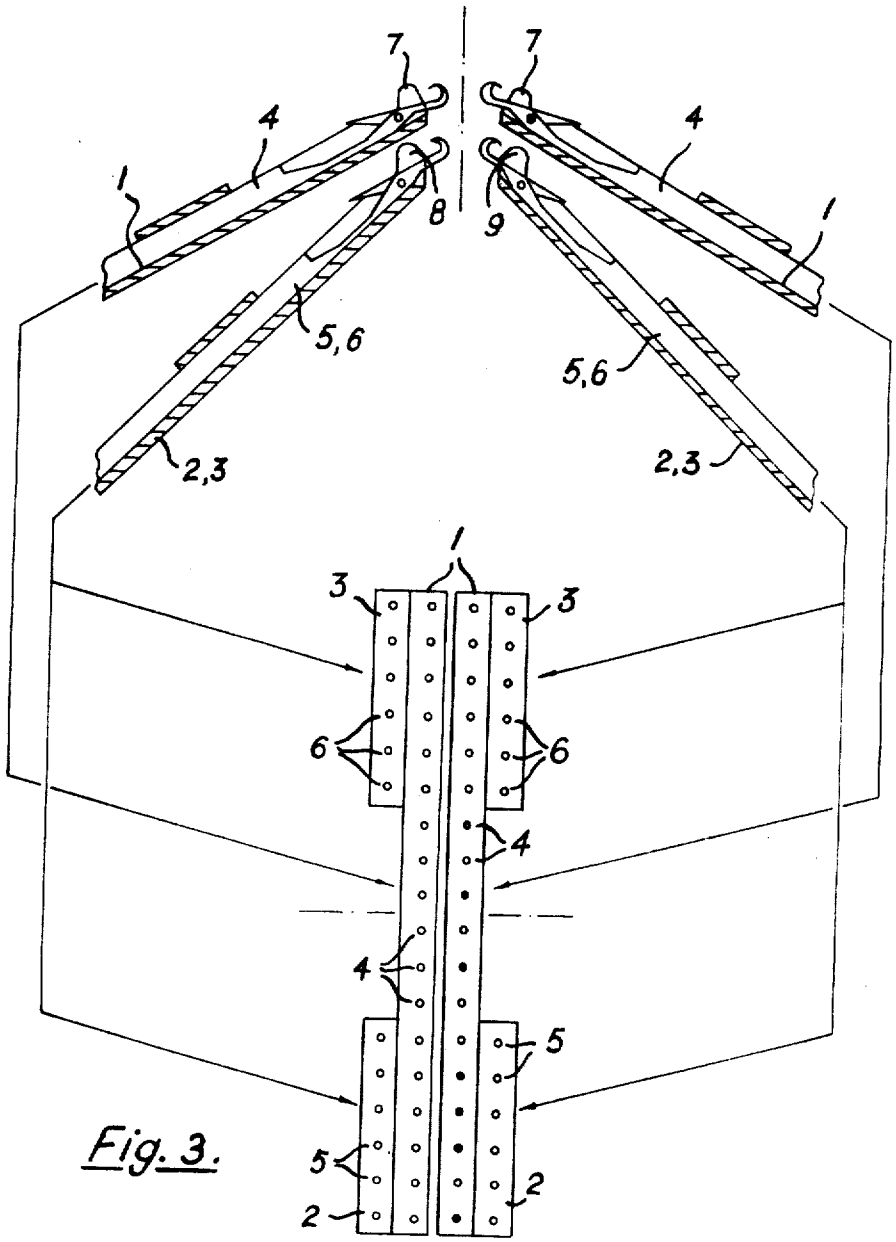


Fig. 3.

Inventor
MAX WILLIAM BETTS &
FRANK ROBINSON
By

DAVIS, HOXIE, FAITHFULL & HAPGOOD *Attorney*

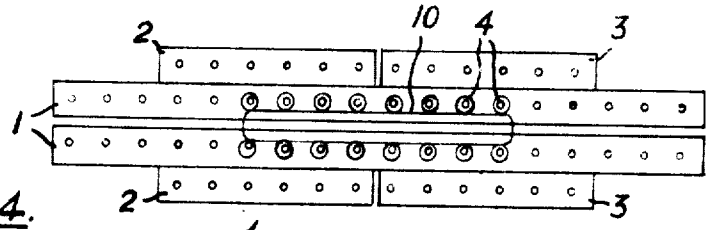


Fig. 4.

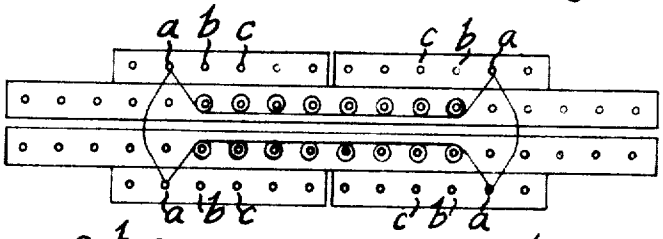


Fig. 5.

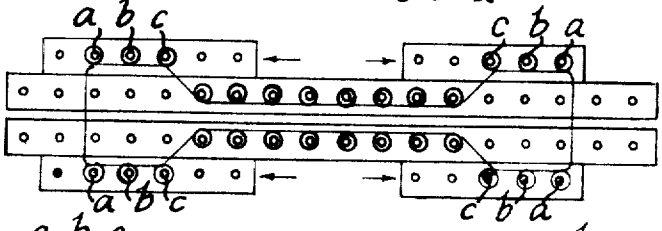


Fig. 6.

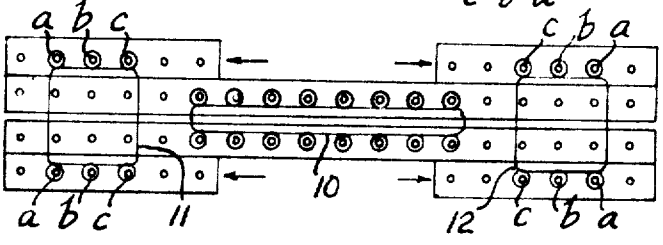


Fig. 7.

Inventor
MAX WILLIAM BETTS &
FRANK ROBINSON
By

DAVIS, HOXIE, FAITHFULL & HAPGOOD *Attorney*

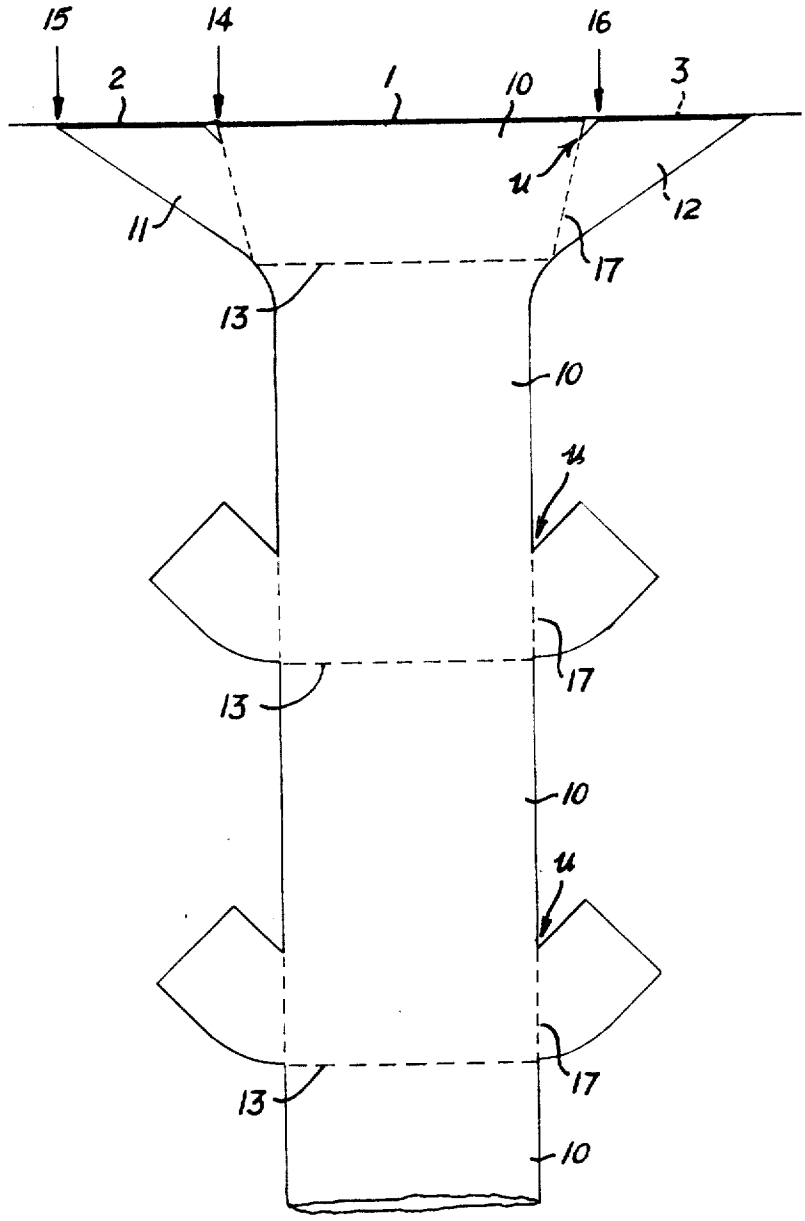


Fig. 8.

Inventor
MAX WILLIAM BETTS &
FRANK ROBINSON
By

DAVIS, HOXIE, FAITHFULL & HAPGOOD *Attorney*

KNITTING OF GARMENTS

This invention relates to the knitting of garments on knitting machines and can be applied to modified flat bar V-bed machines.

By 'flat bar V-bed machine' we mean a machine having at least one pair of opposed straight needle beds lying at an angle to each other so as to define an inverted V-shape, a reciprocating head with cam tracks to co-operate with the butts of needles slidably mounted in grooves or 'tricks' in the needle beds for operating the needles independently of each other, and at least one yarn carrier to traverse the said pair of beds with the reciprocating head for producing knitted loops of yarn on needles which are operated for the purpose.

There are two known methods of producing garments in knitted fabric. In one of these methods flat or tubular knitted fabric is simply cut into suitable shape or shapes for one or more pieces to be secured together to form the garment, usually by stitching together the edges of the piece or pieces. In the other method the component piece or pieces is/are knitted to the shape or shapes required by suitable increase or decrease of the numbers of stitches in the various courses — the process known as "fashioning" — and then again the edges of the piece or pieces are secured together, usually by stitching.

In both these methods considerable labor is involved in "-making up," or securing together the edges of the shaped piece or pieces, and the seams produced are sometimes unsightly. Moreover, seam failure is a common cause of complaint with such garments, either due to inefficient seaming or due to the weakness of the seam causing it to burst during wear. Also in the first mentioned process a considerable quantity of fabric is usually cut to waste, sometimes as much as 40 percent of the total fabric used.

It is now proposed to reduce the labor and wastage involved in these previous methods by knitting a garment or a substantial part of a garment in one integral piece and to this end to employ a modified flat bar V-bed machine with at least two pairs of needle beds, the modifying second pair (which we will refer to as "auxiliary" beds) being mounted to define an inverted V shape above or below the beds which are ordinarily present on a flat bar V-bed machine (which we will refer to as the "main" beds). The auxiliary beds may be inclined to each other at the same angle as that defined by the main beds or at a different angle, and they are movable laterally with respect to the main beds and capable of overlapping them. The planes of the two pairs of beds meet on parallel lines one above the other.

An example of a modified flat bar V-bed machine having two pairs of auxiliary beds above the main beds is the Dubied DFF machine manufactured by Edouard Dubied & Cie., Neufchatel, Switzerland. This machine is described in the "-Dubied Knitting Manual," published in 1967 by Dubied. The DFF machine has auxiliary beds intended for the knitting of narrow selvage strips along the edges of a fabric. Miniature garments (e.g., for dolls) can be knitted on the machine according to the process of the invention, without change. The knitting of full size garments necessitates a few rather elementary modifications of the machine. Specifically, the DFF auxiliary beds carry only sufficient needles to knit the loops of a narrow border of a garment, for example, 15 needles. To provide for manufacture of full size garments the auxiliary beds of the DFF machine should be enlarged.

The main beds of the Dubied DFF machine contain needles, each having a slot to receive the hook of an opposite needle so that a loop can be transferred from a slotted needle to the opposite needle. These needles also have a cranked configuration which avoids shogging or racking (i.e., lateral movement) of the beds to obtain the required needle alignment. If such needles and associated cam means are provided for the auxiliary beds automatic stitch transfer between the main and auxiliary beds can be carried out.

In the DFF machine, the auxiliary beds are pivoted on a transverse bar so that they can be swung to lift the needles clear of the knock-over bits of the main beds during lateral movement. Lateral movement, to effect narrowing, is accomplished by means of a pawl on the cam carriage, and may be carried out to the extent of almost half the length of the main beds, for each pair of auxiliary beds.

It will be understood that the DFF machine and its components are simply exemplary of machines and mechanisms which may be used to practice the invention and that the invention, which is concerned with a method of knitting a garment or substantial part thereof in one integral piece by a new sequence of knitting steps, may be performed on machines of other manufacture.

According to this invention a method of knitting a garment on a knitting machine having at least two pairs of opposed beds which are laterally movable with respect to one another and can overlap comprises knitting a first portion of the garment in the form of a tube on needles of at least two pairs of opposed beds of the machine, widening said first tubular portion by introducing needles on a first pair of beds at a point closer to those needles of a second pair of beds carrying stitches, than the needles of the first pair of beds which are already carrying stitches and which aremost remote from said needles of the second pair of beds and further widening the tubular portion by introducing needles in following courses of knitting at points closer to the needles of the second pair of beds than the needles first introduced, thereby forming a group of stitches on each pair of beds, and knitting separately on to each group of stitches to produce a further tubular portion on each pair of beds.

Tubular knitting may be carried out on many conventional V-bed machines by a method in which knitting takes place on only one side of the machine in each traverse, and on completion of each traverse knitting is commenced in the reverse direction, using the same yarn carrier, only on the other side of the machine, as described, for example, on pages 59 and 60 of the Dubied Manual. If each traverse is complete, this produces fabric, which though knitted in a flat condition, is continuous across the ends of the traverse, and can be opened out into a tube, but if each traverse of the needles of one of the beds is reversed at an intermediate point in the bed an incomplete tube is produced, such as the body portion of a front-fastening style of garment. If tubular knitting is commenced with complete traverses in each direction and then after an appropriate number of rows the subsequent traverses are reversed at an intermediate point on one of the beds, a tube with an opening in part of its length is produced, and this could be used for a body portion of a garment with a front opening at the neck. If the reversed traverses are progressively reduced, a V-neck style will result. In referring herein to a tubular portion we include, where appropriate, both a complete tube and a tube with such a longitudinal opening.

The knitting of a portion of a garment in the form of a tube can also be carried out on many conventional V-bed machines by traversing the opposed beds with different yarn carriers at the same time and at the end of the traverse crossing the yarn carriers over so that each presents its yarn to the opposite bed. This method of knitting (often referred to as "double system" tubular knitting, as described, for example, on pages 107 and 108, and illustrated on page 110 of the Dubied Manual) also produces two flat pieces of fabric joined at the ends of the traverses, that is a tubular piece of fabric.

By the method of the invention, and using such tubular knitting methods it is possible to knit, for example, an integral garment for the lower part of the body in which the tubular leg portions lie at an angle to each other. If a machine with two pairs of auxiliary beds is used, a sleeved body garment may be knitted in which the tubular sleeves are appropriately inclined to the tubular body portion. Moreover, by shogging the auxiliary beds away from the stitches carried on the main beds it is possible to widen the appropriate parts of the garment by introducing needles in the main or auxiliary beds, so avoiding the necessity of transferring stitches.

It will be understood that in order to knit continuously in the manner described, each of the pair or pairs of beds in which needles are introduced must be moved laterally away from the stitches carried on the adjacent bed by one pitch for each needle introduced so that the needles upon which knitting is to take place all lie one pitch apart.

The first tubular portion of a garment may be knitted initially on only one pair of beds, and needles may then be introduced on an adjacent pair of beds to extend the tubular portion onto these beds, or, on a machine equipped with stitch transfer facilities, some stitches may be transferred to that adjacent pair of beds.

It will be understood that when the stitches are rearranged into groups, further knitting may continue simultaneously on the separate groups, or on each group in succession. If, as is preferred, knitting is to be simultaneous then one or more new yarn carriers must be introduced to provide at least one yarn carrier for each group. Machines equipped with several yarn carriers for knitting several separate pieces of fabric are well known, as for example, that illustrated on Page 31 of the Dubied Manual, and thus it is obviously possible to knit separate tubular portions on the main and auxiliary beds of a modified Dubied DFF type machine, using either single or double system.

When the beds are moved to rearrange the stitches into groups, one or more spare needle pitches may be, and preferably are, left between the groups. This enables the further tubular portions to be knitted simultaneously without the yarn carriers interfering with each other.

One or more of the further tubular portions may be cast off before the other or others are completed. For example, in knitting a short sleeved body garment or a garment with a full length body, for example a ladies' dress, the sleeves will usually be cast off before the body is completed. When the body portion of such a garment is completed, a draw thread may be knitted in, after which knitting can be continued to form the neck part of the next garment. Needles are then introduced, or stitches transferred, as described, to extend the first tubular portion onto the other pairs of beds, after which these beds can be moved to separate the stitches again, and the process is continued as before. By this means a succession of garments can be produced in a chain, joined by the draw threads.

Any of the tubular portions may, of course be widened or narrowed, by conventional means, apart from the widening mentioned, for giving shape to the garment.

Examples of the invention are illustrated by the accompanying drawings in which:

FIGS. 1 to 3 are diagrammatic sketches, each showing an elevation and a plan, of three arrangements of knitting machines capable of producing a sleeved garment by the method of the invention,

FIGS. 4 to 7 are plans of the machines shown in FIGS. 1 to 3 showing diagrammatically successive stages in the manufacture of a garment, and

FIG. 8 is a sketch of part of a chain of garments being manufactured.

FIG. 1 shows diagrammatically in elevation and plan a flat bar V-bed machine having a pair of opposed needle beds 1, which will be called the 'main' beds, and above these beds two pairs of laterally movable opposed beds 2,3, which will be called the 'auxiliary' beds, which overlap the main pair of beds 1. To explain the alignment of the beds, a needle 4 of one bed 1 and a needle 5 of a bed 2 on the opposite side are shown in their raised positions. It will be observed that the auxiliary beds 2 and 3 are disposed at such an angle to the beds 1 that their needles 5,6, when raised, enter the upper parts of the tricks of the main beds 1, between the knock-over bits 7, and it will thus be appreciated that for any needle of a bed 2 or 3 to knit, that bed must be positioned with its needle tricks aligned with the tricks of the bed 1 below it. When the needles 5 or 6 of a bed 2 or 3 are withdrawn, that bed can be moved laterally with respect to the beds 1. The beds 1 can also be arranged to be moved laterally if required. It will also be observed that the disposition of the beds is such that knitting can take place either in structures formed between the needles 4 of the opposite main beds 1, or between the needles 4 of one main bed 1 and the needles 5 or 6 of an opposite auxiliary bed 2 or 3, or between the needles 5 or 6 of the opposed auxiliary beds 2 or 3, or in tubular form on the same combination.

Provision is made for either the main beds 1 to be lowered, or the auxiliary beds 2 and 3 to be raised so that when the latter carry loops of knitted fabric they can be moved laterally without the loops fouling the knock-over bits 7 of the beds 1.

The plan in FIG. 1 shows diagrammatically the three pairs of beds and the positions of their needles, the beds of each pair being positioned opposite to each other and the beds being symmetrically arranged with respect to each other, although, as mentioned, the beds 2 and 3 are movable from this position, and the beds 1 may also be movable.

FIG. 2 shows diagrammatically an elevation and plan of a different form of machine which is generally similar in arrangement to that shown in FIG. 1, but in which the two pairs of auxiliary beds 2, 3 above the beds 1 are differently disposed so that their needles 5, 6 do not share the needle tricks of the main beds 1, and the beds 2 and 3 carry their own knock-over bits 8, 9. The performance of this machine is broadly similar to that described in relation to FIG. 1, but in this case there is no necessity for raising or lowering the beds in order to enable the beds 2 and 3 to be moved, since fabric with loops carried on the needles 5 or 6 will automatically be held clear of the knock-over bits 7 of the beds 1.

FIG. 3 is a similar drawing showing a machine in which the two pairs of auxiliary beds 2, 3 are below the main beds 1.

It will be noted that the plans are the same in each of FIGS. 1 to 3, and the following Figures show the same plans with the beds in various positions according to the function being performed.

In FIGS. 4 to 7 the plans are drawn horizontally for convenience, and the beds shown uppermost are those at the rear of the machine while the front beds are shown lowermost. Tubular knitting carried out using one yarn carrier will be described with reference to FIGS. 4 to 7 and takes place from left to right of the drawing on the rear beds and from right to left on the front beds. It will be understood that the number of needles and stitches shown is purely diagrammatic in order to simplify the drawing, and does not in any way relate to the number of stitches in a garment.

FIG. 4 shows a single tubular portion 10 knitted on needles 4 of the main beds 1. This tubular portion 10 comprises sufficient wales to give the width necessary for the body portion of the garment to be produced, but it may, for some styles of garment, have been widened from a narrower tube of width suitable for the neck opening of the garment.

To form the shoulders of the garment, the tubular portion 10 is widened by introducing needles on the auxiliary beds 2 and 3. FIG. 5 shows the first stage of such widening in which one needle *a* is introduced, to produce a tuck stitch (wrap of yarn), on each of the auxiliary beds 2 and 3, the tubular portion 10 then being carried by all three pairs of beds. These tuck stitches will be followed by full knitted loops in the following courses of knitting, as is known. Further needles are introduced during the following courses to provide the desired width for the sleeves of the garment. The needles are always introduced on the laterally inner side of the needles *a*, that is on the same side of the needles *a* as the rest of the tubular portion 10, and needles may be introduced in each course or only in some of the courses. All the needles to be introduced to provide the sleeve width must, however, be introduced during the knitting of only that number of courses required to provide the desired length of fabric between the top of the shoulder and the underarm of the garment. Each time a needle or needles is/are introduced, the bed 2 or 3 carrying that needle, or these needles, is moved laterally outwardly by one needle pitch for each needle introduced. FIG. 6 shows the last course before the underarm, when two further needles *b* and *c* have been introduced on each of the auxiliary beds 2 and 3.

To form the sleeves of the garment, the pairs of auxiliary beds **2** and **3** are each moved laterally outwardly by one needle pitch to separate the stitches into groups, one on each pair of beds, and two additional yarn carriers are brought into operation so that one carrier will traverse each pair of beds. For example the original yarn carrier may be stopped at the left hand side of the machine, to traverse the auxiliary beds **2**, and new yarn carriers will be introduced at the left hand side of each of the groups of needles carrying stitches on the beds **1** and **3**. The beds could, of course, be moved apart more than one needle pitch, but at least one pitch is required to provide clearance for the yarn carriers.

Knitting is then continued, with the three yarn carriers knitting successively in each traverse of the reciprocating head, producing three separate tubular portions; the original tubular portion **10**, on beds **1**, which forms the body of the garment, and tubular portions **11** and **12**, on the needles of beds **2** and **3** respectively, which form the sleeves of the garment. FIG. **7** shows this situation.

After an appropriate number of courses have been knitted to provide the desired length of sleeves for the garment, the stitches carried on the auxiliary beds **2** and **3** are pressed off, and knitting is continued on the needles **4** of the beds **1**, to produce the required length of the body portion of the garment. After this length has been knitted, a draw thread is inserted, and knitting continues to produce the neck part of the next garment, the auxiliary beds **2** and **3** being returned to their original positions, and the situation then again being as shown in FIG. **4**.

FIG. **8** shows diagrammatically the production of a succession of garments in a chain, linked by draw threads **13**, in the manner described. At the top of the Figure are shown the tubular body portion **10** and sleeve portions **11**, **12** being knitted with separate yarn carriers **14**,**15** and **16** on the three pairs of beds **1**, **2** and **3**. The end of the body portion **10**, which forms the neck opening of the garment, is joined by a draw thread **13** to the other end of the body portion **10** of the previous garment.

Each of the garments is thus commenced, knitting only on the beds **1**, immediately after the draw thread, and after only one or two courses the first needles *a* are introduced on the auxiliary beds **2** and **3** to begin the formation of the shoulder part of the garment. During further knitting, to the underarm position indicated by the arrows *u*, further needles are introduced in the auxiliary beds **2** and **3**, as described for the needles *b* and *c*, to provide the required width of sleeve, and at the same time the beds **2** and **3** are moved laterally outwardly as each needle is introduced.

When the underarm position *u* is reached, the auxiliary beds **2** and **3** are moved outwardly to separate the stitches they carry from the stitches which form the body portion **10**, additional yarn carriers are introduced, and the body and sleeve portions are knitted separately.

The garments are thus produced in a continuous chain joined by the draw threads **13**. On withdrawal of these draw threads **13** the garments become separated, and may then be complete except for hemming the extremities, or, if required, rib or other trimmings may be attached at the extremities in the usual way.

The garments described have a neck width the same as the body width. If a narrower neck is required some waste courses may be knitted on the main beds **1**, after the draw threads, narrowing, by withdrawal of needles, to the desired neck width. A second draw thread is then introduced after which the tubular portion **10** is gradually widened, to the width required for the inside of the shoulders of the garment, after which the process continues as described above.

A different style, similar to a Raglan sleeve, can be produced by introducing the needles *a* on the auxiliary beds when the tubular portion **10** is of only the neck width, and widening this portion **10** by needle introduction at the same time as further needles are being introduced to form the sleeve widths. Various different styles can be produced by varying the order and number of needles introduced on the different beds. When needles are introduced in the main beds **1**, the auxiliary beds **2** and **3** will be moved laterally outwardly to accommodate them as well as any needles introduced on these beds.

The introduction of needles in the manner described in the auxiliary beds **2** and **3** causes the sleeves, when relaxed, to lie at an angle to the body portion of the garment, as shown in FIG. **8**, and as shown, produces a style line **17** at the junction between the body and sleeves.

A trouser-like garment can be produced in a similar manner, using only the main beds and one pair of auxiliary beds, and forming the initial tubular portion, of the desired width for the waist, half on each pair of beds. Needles are introduced as appropriate, at or near the laterally inner edge of each bed, and the beds would then be moved apart to separate the stitches into two groups, after which a further tubular leg portion is knitted on each group. Garments of this type cannot, of course, be knitted in a continuous chain, but have to be cast off when the required leg length had been knitted, after which a new single tubular waist portion is cast on.

Any of the tubular portions, may, of course, be widened or narrowed as required, apart from the widening already mentioned, by conventional means, to give shape or style.

Although a chain of garments connected by draw threads has been described, it will be understood that a continuous chain of ordinary knitting could be produced and the garments would then be separated by cutting.

What is claimed is:

1. A method of knitting a garment on a knitting machine having at least two pairs of opposed beds which are laterally movable with respect to one another and can overlap, which comprises knitting a first portion of the garment in the form of a tube on needles of at least two pairs of opposed beds of the machine, widening said first tubular portion by introducing needles on a first pair of beds at a point closer to those needles of a second pair of beds carrying stitches, than the needles of the first pair of beds which are already carrying stitches and which are most remote from said needles of the second pair of beds and further widening the tubular portion by introducing needles in following courses of knitting at points closer to the needles of the second pair of beds than the needles first introduced, thereby forming a group of stitches on each pair of beds, and knitting separately on to each group of stitches to produce a further tubular portion on each pair of beds.

2. A method according to claim **1** wherein the said first tubular portion of the garment is knitted initially on only one pair of beds and needles are then introduced on an adjacent pair of beds to extend the tubular portion onto these beds.

3. A method according to claim **1** wherein the said first tubular portion of the garment is knitted initially on only one pair of beds and stitches are then transferred from needles of the said one pair of beds to needles of an adjacent pair of beds to extend the tubular portion onto these beds.

4. A method according to claim **1** wherein the beds are moved to rearrange the stitches into groups, with one or more spare needle pitches left between the groups and the further tubular portions are knitted simultaneously.

5. A method according to claim **1** wherein at least one of the further tubular portions is cast off before the other or others is completed.

6. A method according to claim **1** wherein a draw thread is knitted in after completion of a garment and knitting of another garment is then commenced thereby producing a succession of garments in a chain joined by draw threads.

7. A method of knitting a garment on a knitting machine having at least two pairs of opposed beds which are laterally movable with respect to one another and can overlap, which comprises knitting a first portion of the garment in the form of a tube on the needles of each of a first pair of two opposed beds of the machine, widening said first tubular portion by introducing needles on each bed of a second pair of opposed beds laterally movable with respect to said first pair of beds, said needles being adjacent the outermost needles used to knit

said first tubular garment on said first pair of beds, and further widening the first tubular portion by introducing needles in following courses of knitting at points closer to the needles of the first pair of beds than the needles of the second pair of beds first introduced, thereby forming a group of stitches on each pair of beds, and knitting separately onto each group of stitches to produce a further tubular portion on each pair of beds.

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