

Sept. 9, 1952

L. PICARD

2,609,677

KNITTING

Filed Sept. 24, 1946

10 Sheets-Sheet 1

Fig. 1

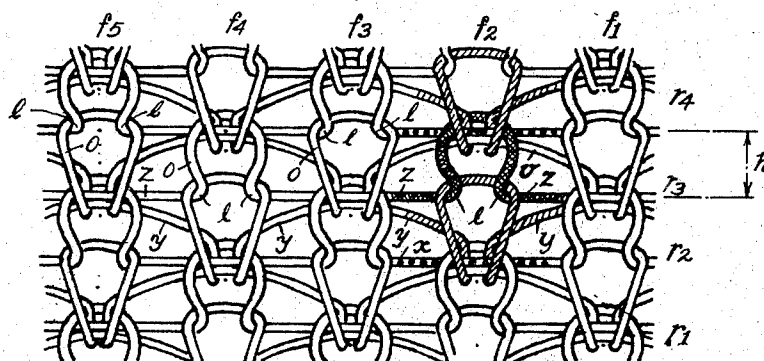
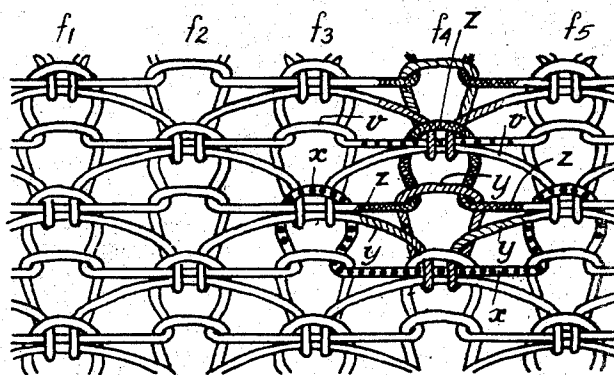


Fig. 2



INVENTOR

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By Watson, Cole, Hummel & Watson

Sept. 9, 1952

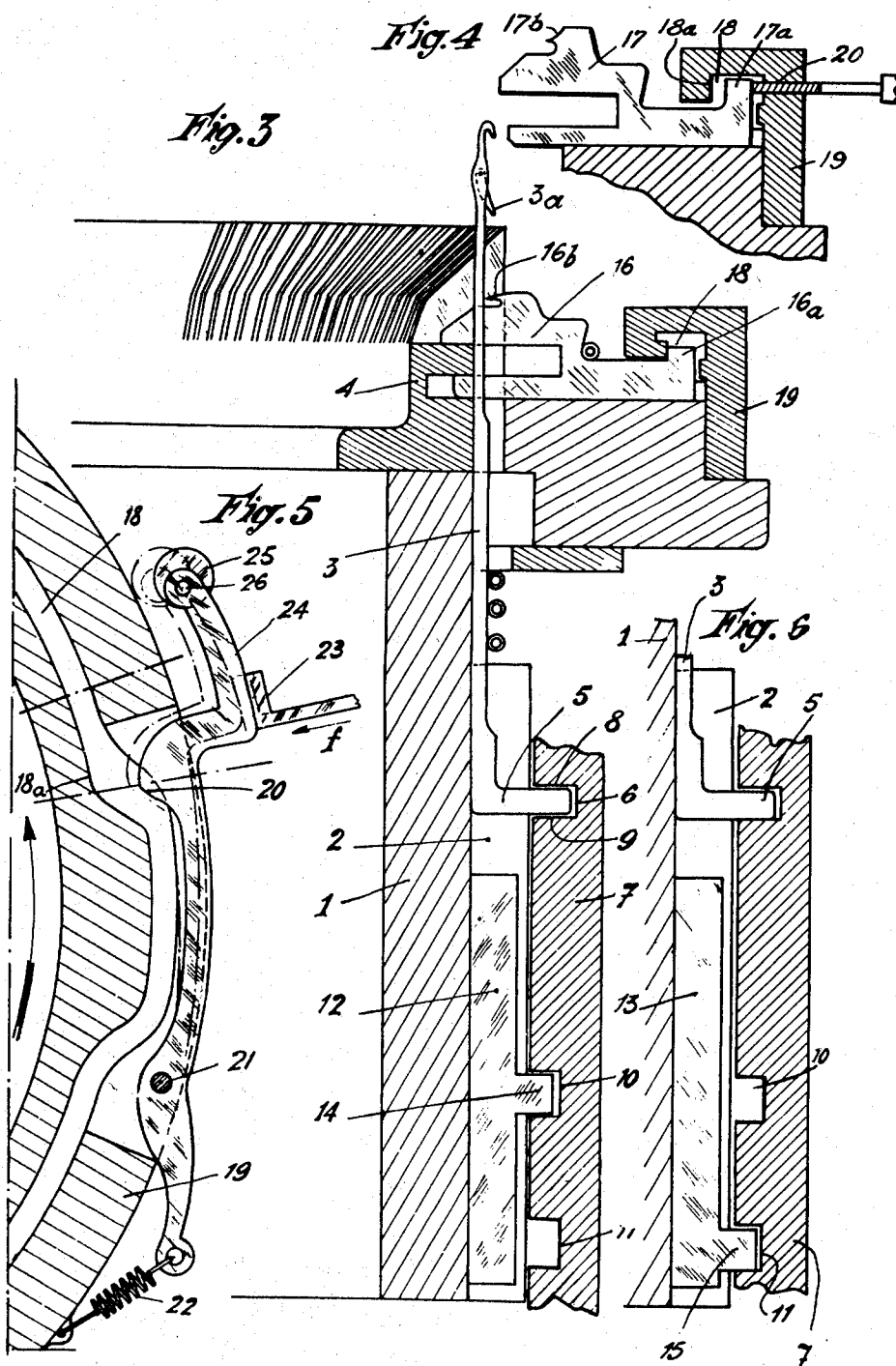
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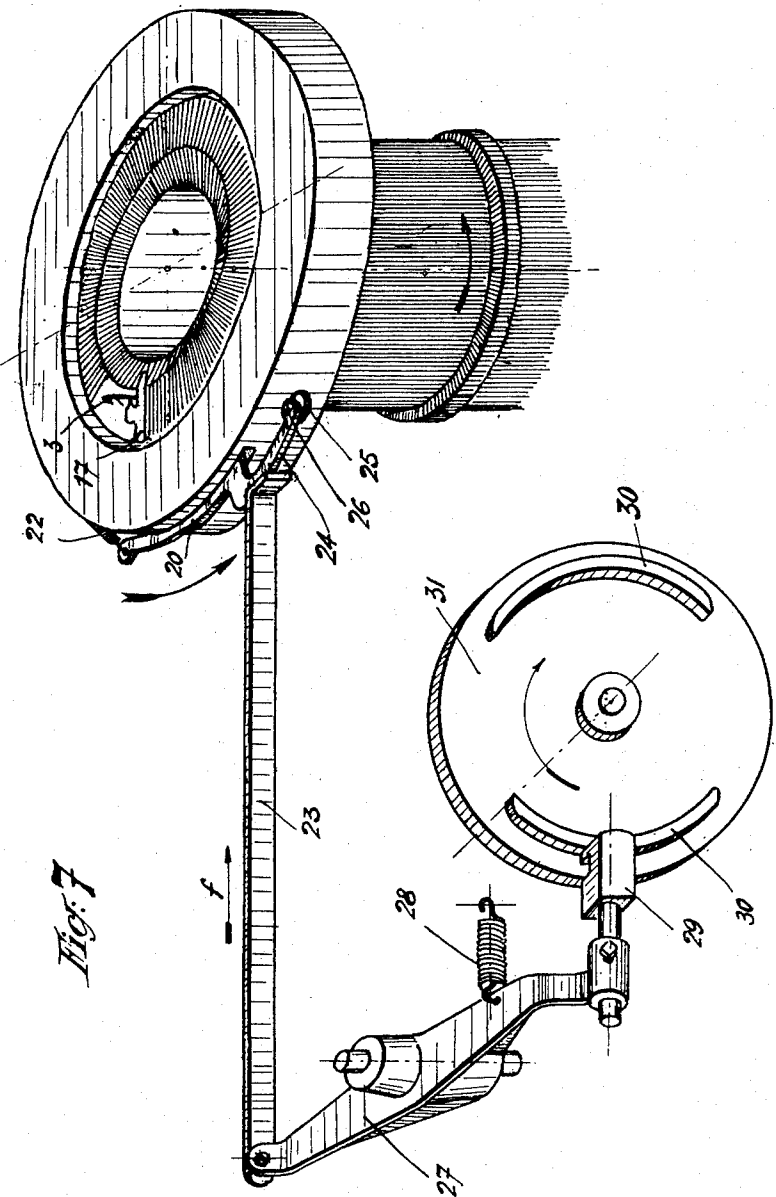
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Fig. 8

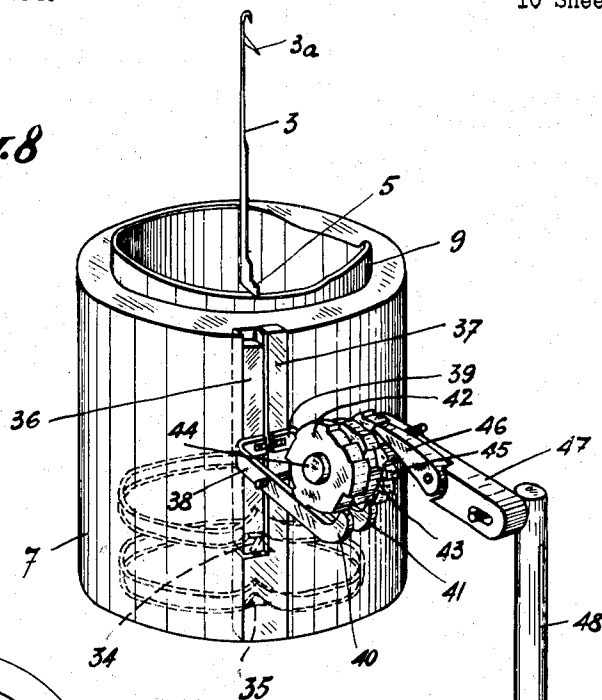


Fig. 13

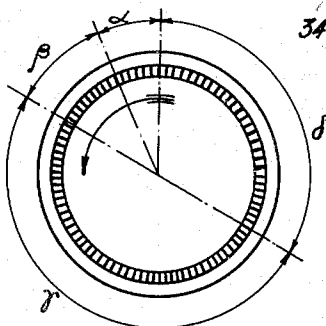


Fig. 9

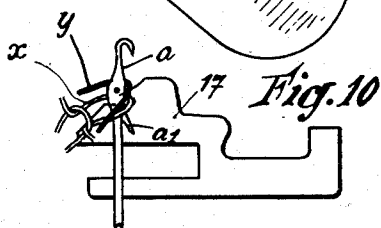
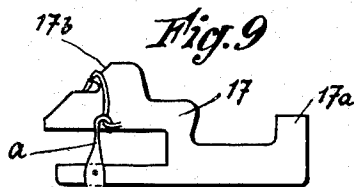


Fig. 11

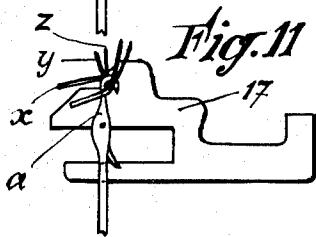
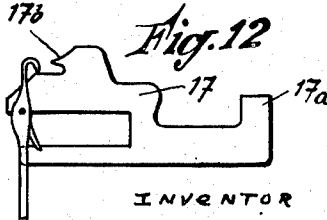


Fig. 12



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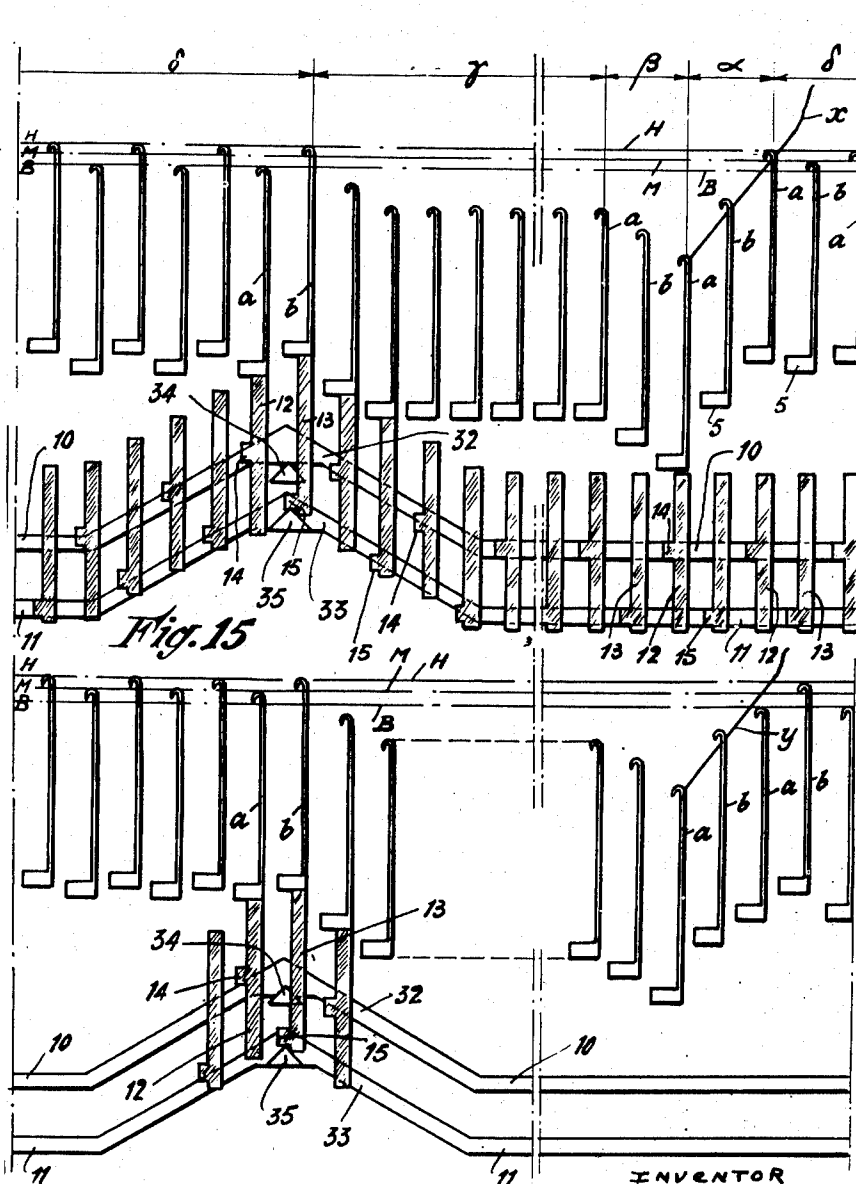
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Fig. 16

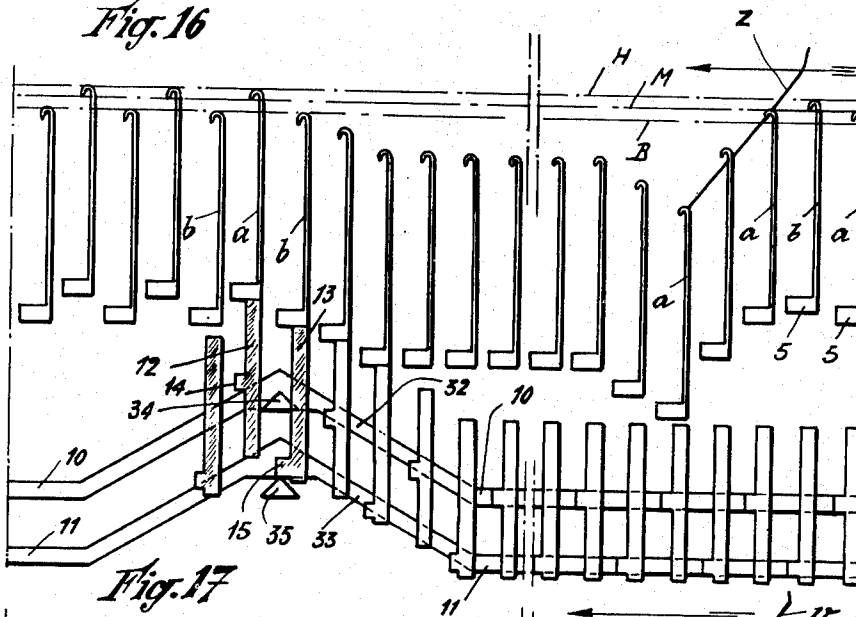


Fig. 17

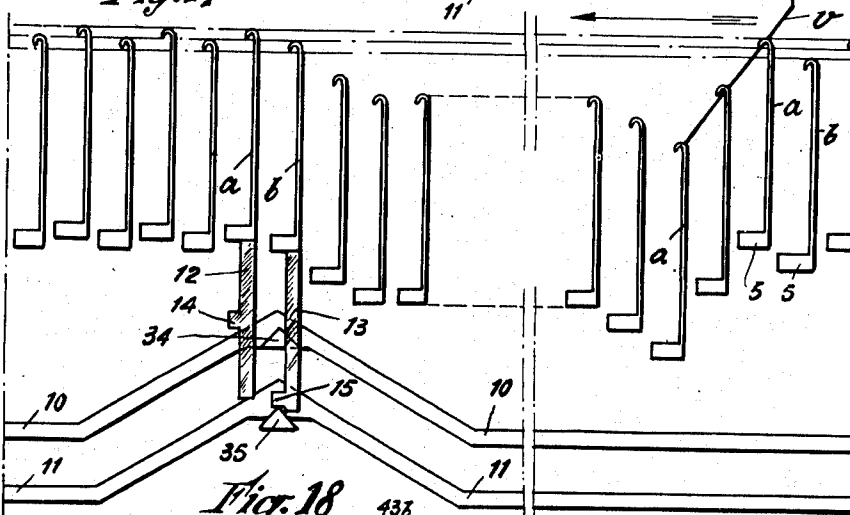
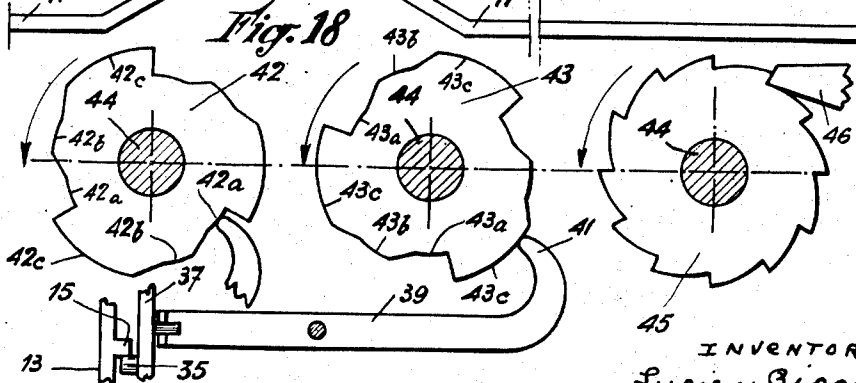


Fig. 18



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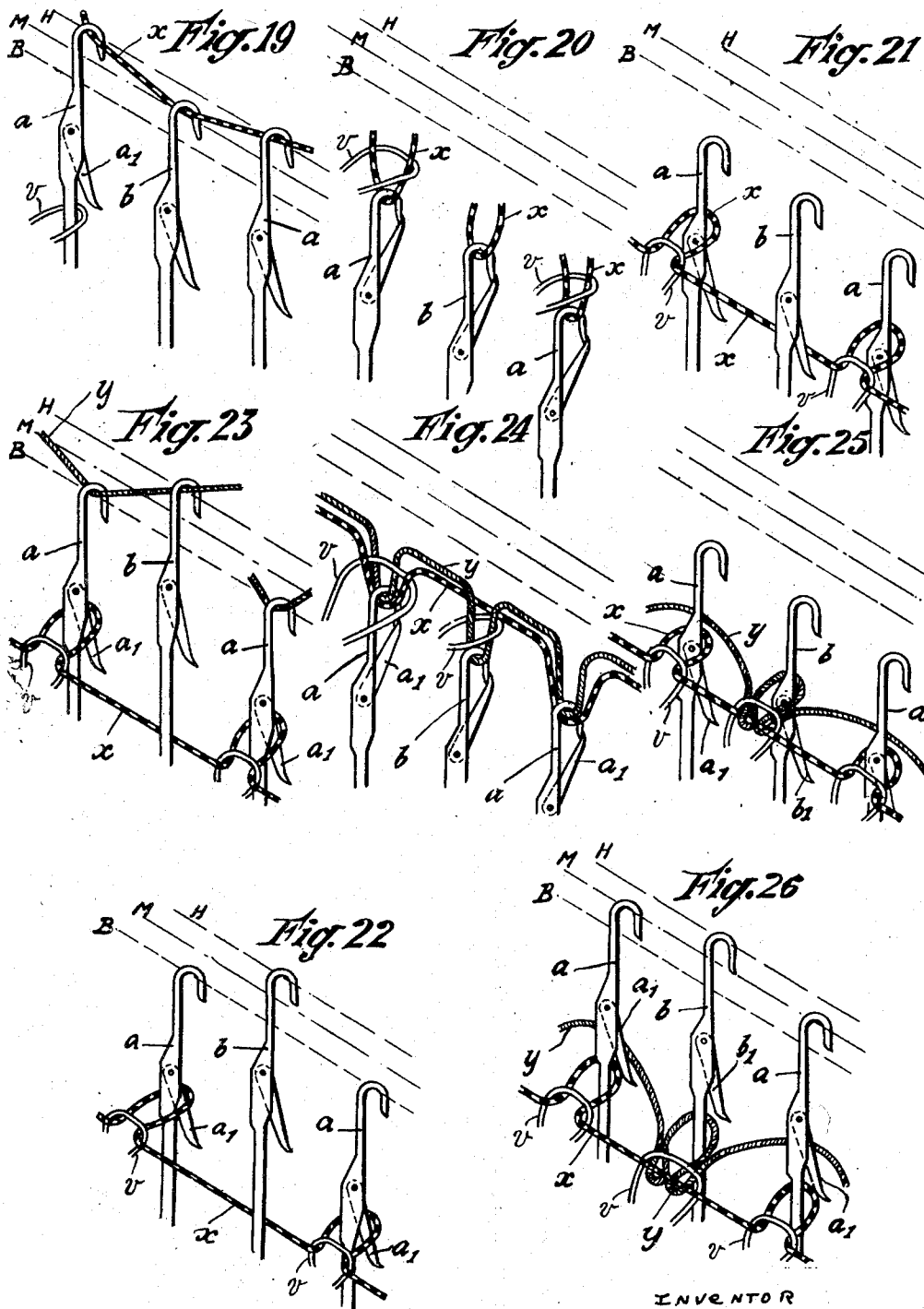
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INVENTOR

Lucien Picard

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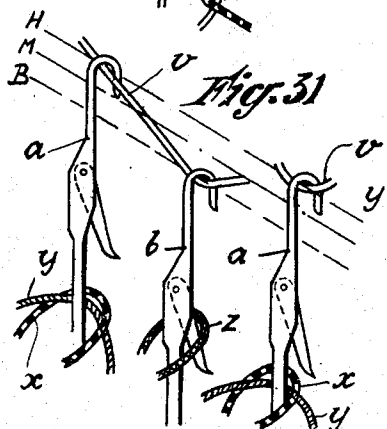
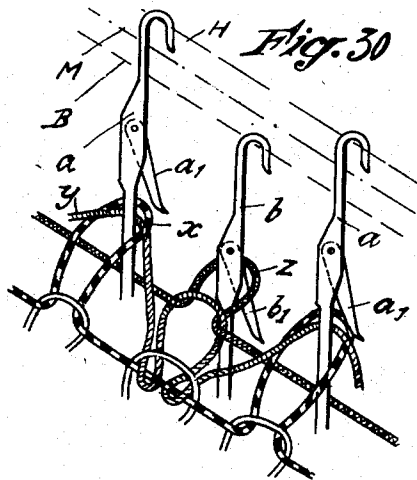
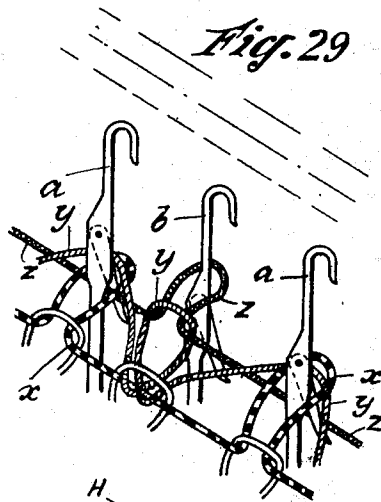
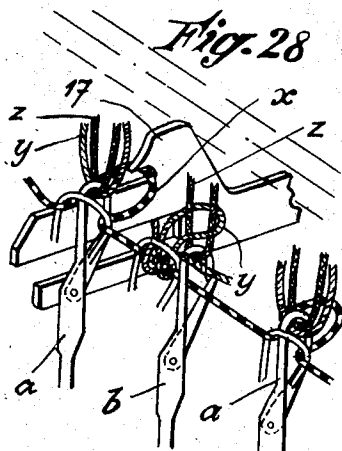
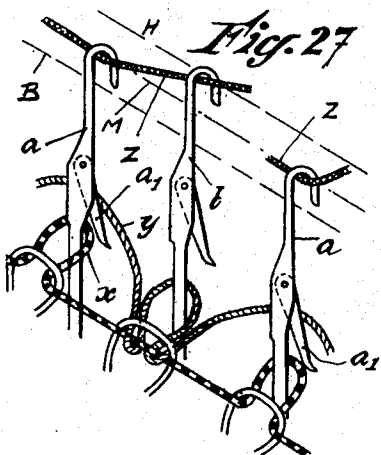
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INVENTOR
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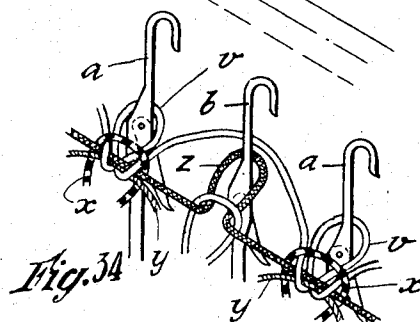
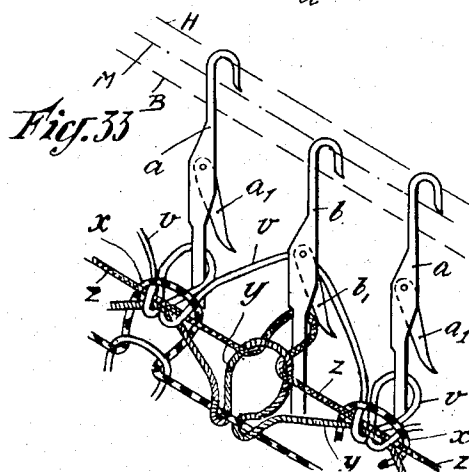
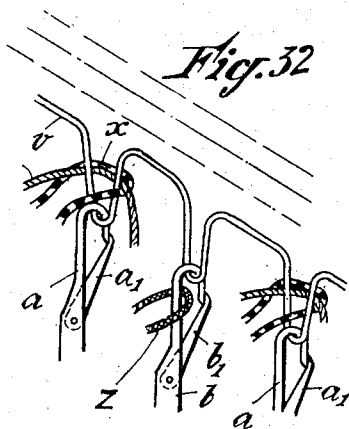
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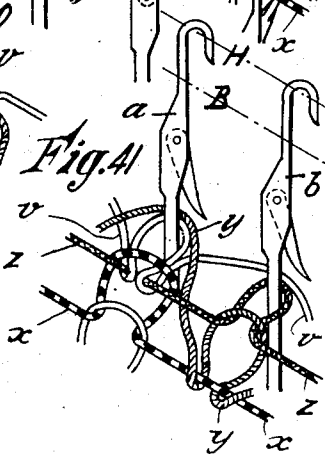
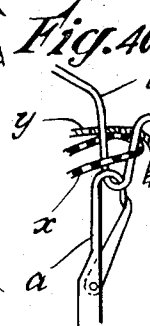
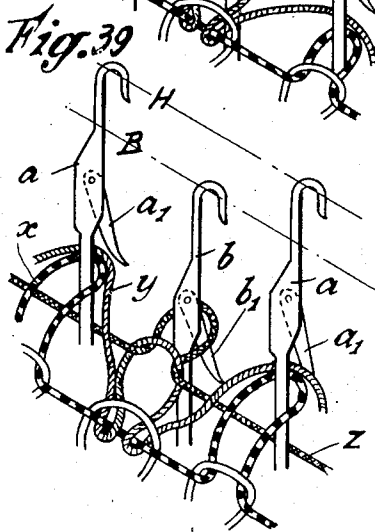
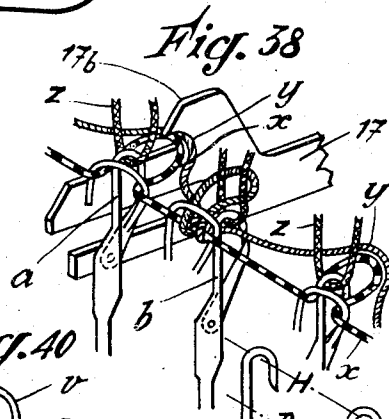
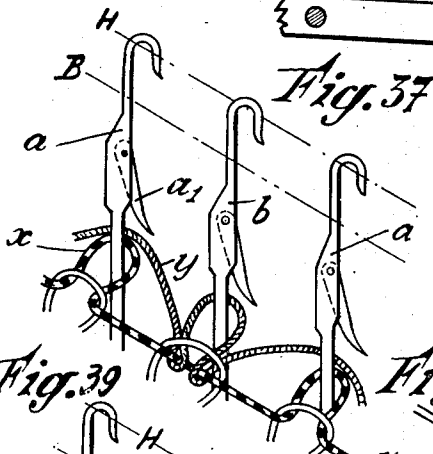
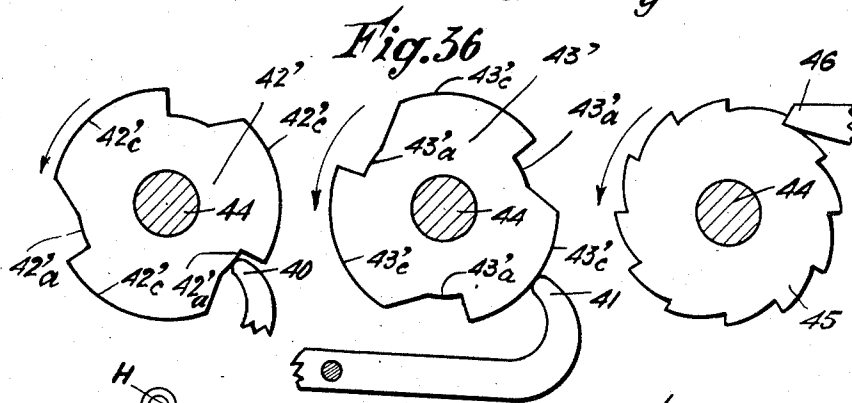
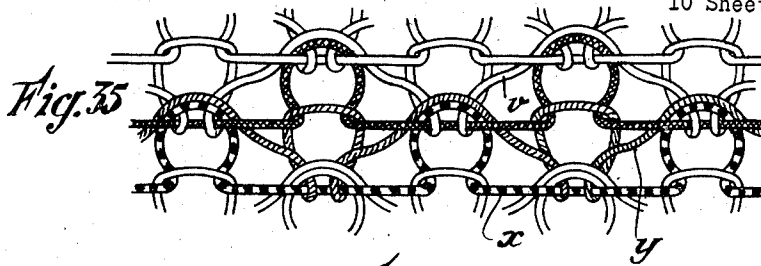
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L. PICARD
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10 Sheets-Sheet 10



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UNITED STATES PATENT OFFICE

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KNITTING

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twelfths to Louis Carbonnaux, Sainte-Savine,
and one-twelfth to Jean Manotte, Sainte-
Savine, France

Application September 24, 1946, Serial No. 698,885
In France October 16, 1945

2 Claims. (Cl. 66—169)

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This invention relates to knitting.

The rows of stitches formed on the thread and connected together by the same thread that makes them, are hereinafter referred to as "courses." The rows of stitches formed by the loops and stitches of successive courses are hereinafter referred to as "lines."

There have already been conceived various systems of stitching which will not run down, hereinafter referred to as "stitches" with a view to producing a practically unladderable knitted fabric. These systems present generally inconveniences: the knitting assumes a coarse appearance, it lacks elasticity and finally its manufacture is onerous.

The present invention has for its object to produce in the first place, an unladderable knitted fabric formed by knitting a single thread, and having an aspect approaching that of ordinary knitting.

In accordance with the present invention, I provide unladderable knitted fabric formed by a single thread constituting unelongated stitches and elongated stitches having substantially the same height as the unelongated stitches, and the unelongated stitches occurring alternately with the elongated stitches in each course and in each line so that, from one course to the other, the unelongated stitches and the elongated stitches are in quincunx and that in each course the elongated stitches are looped by the unelongated stitches of the preceding course, the said elongated stitches being in intertwining relation with the loop of thread connecting the elongated stitches formed in the preceding course, and the rectilinear elements of thread connecting the successive unelongated stitches in the course considered, the said rectilinear elements of the various courses being substantially parallel to each other while the looped parts of the thread comprised between two elongated stitches of two successive courses are disposed diagonally.

According to one method of producing the unladderable knitted fabric, each elongated stitch is looped by the unelongated stitch of the preceding course and grips the rectilinear thread element uniting the two unelongated stitches which are disposed on both sides of the said elongated stitch and the collar connecting the two elongated stitches of the preceding course which are disposed on both sides of the unelongated stitch ensuring the looping so that the parts of the collar connecting the two elongated stitches are disposed diagonally.

According to another method of producing the

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unladderable knitted fabric, each elongated stitch is looped by the unelongated stitch of the preceding course and it grips the rectilinear thread element uniting two unelongated stitches which are disposed on both sides of the elongated stitch; the unelongated stitch securing the looping is doubled by the thread of the collar so that, as in the first method of formation, the parts of the collars connecting two elongated stitches are disposed diagonally.

The invention has furthermore for its object a machine for carrying out a method of producing unladderable knitted fabric such as specified above, which comprises mainly the following features:

The needles are divided into two groups, the needles of one group alternating with the needles of the other group.

The needles of one group (that is to say alternate needles) for example the even numbered needles are so actuated that, beginning with the formation of the course they produce, on each of them, an unelongated stitch whilst the needles of the other group or odd numbered needles, although fed with thread, do not knit but distribute their thread to constitute the rectilinear thread element connecting two adjacent unelongated stitches.

In one course out of every two, at the moment of taking down or casting-off, for the aforesaid even needles, there is provided a longer feed of thread than for the aforesaid uneven needles which should then form the unelongated stitch, this supplementary length of thread being provided to form the collar connecting the elongated stitches.

According to one method of carrying out the manufacturing process, the elongated stitch looped by the unelongated stitch preceding it in the line, is obtained by taking down the loop formed by the thread constituting the collars, simultaneously on the collar formed in the preceding course and on the rectilinear thread element connecting the two successive unelongated stitches in the course being formed.

According to another way of carrying out the manufacturing process, the elongated stitch is obtained by taking down the loop formed by the thread forming the collars only on the rectilinear thread element connecting the two unelongated adjacent stitches in the course being formed; it is looped simultaneously by the unelongated stitch preceding it in the line and by the collar connecting two adjacent elongated stitches in the preceding course.

The needles which, in one course, have not formed the unelongated stitches form them in the preceding course; thus there is obtained the formation of unelongated stitches disposed in quincunx with the elongated stitches.

Four consecutive courses of knitting are necessary to form the contexture of the latter. In one and the same course the needles of one group work differently from those of the other group but the work of the needles is identical in the third course where the needles of the second group carry out the same work as that of the needles of the first group in the first course; and that in the fourth course the needles of the second group carry out the same work as that of the needles of the first group in the second course and so on.

This work of the needles is carried out as follows:

In each of the courses, all the needles take up or draw the thread distributed.

According to one method of manufacture, in the first course the needles of the first group (for example even numbered needles) take down the stitches but keep them under their hooks, whilst the needles of the second group (odd numbered needles) take down and stitch normally, thus producing an unelongated stitch.

In the second course, the even needles take up a length of the thread longer than that necessary for the formation of an ordinary stitch, they take down but without stitching and keep under their hooks the elongated loops formed by the thread distributed in this course, whilst the stitch formed in the first course is disengaged from the hook. Throughout this course, the odd needles take down, stitch and keep the stitches under their hooks.

In the third course, the even needles which have, under their hooks, the elongated loops take down but leave the stitches formed in the first course under the elongated loops. The odd needles stitch like the even needles in the first course, that is to say they take down and keep the stitches under their hooks.

In the fourth course, the even needles stitch like the odd needles throughout the second course, that is to say they take down and keep the stitches under their hooks, these stitches will be taken down in turn and will thus form normal stitches. The odd needles stitch like the even needles in the second course; they take up a long loop, they take down, but without stitching and keep under their hooks the elongated loops.

According to another method of manufacturing, in the first course the even needles and odd needles carry out the same work as that described for the first method of manufacture.

In the second course, the even needles take up a length of thread longer than that necessary for the formation of an ordinary stitch; they take down but without stitching and the stitches formed in the first course besides the elongated loop of collar formed by the thread distributed in the second course are disengaged on the needles outside the hooks. Throughout this course, the odd needles take down and keep the stitches under their hooks.

In the third course, the even needles take down but do not stitch; at the end of the cycle of this course the stitches formed in the first course and the elongated collars are then disposed on the needles, as they were at the end of the second course. The odd needles work like the even

needles in the first course, that is to say they take down and keep the stitches under their hooks.

In the fourth course, the even needles work like the odd needles throughout the second course; they take down and the thread distributed in this fourth course is looped simultaneously by the thread distributed in the first course and by that distributed in the second course, that is to say that forming the collars; the stitches thus looped remain under the hooks and will be released in turn and will then form normal stitches. The odd needles stitch like the even needles in the second course; they take up long loops, they take down but without stitching and keep under their hooks the elongated loops.

The invention has also for its object a circular machine, of the English machine type, equipped with latch or "self-acting needles" for producing unladderable knitted fabric in accordance with the manufacturing processes described above.

To this end and in accordance with the invention, the machines are provided with members, for example with vertically movable jacks, capable of selecting needles: so as to divide them into two groups: a group of even needles and the group of odd needles. The arrangement of these jacks is such that the needles of one group are presented for taking up at a different height from those of the other group consequent on their rise, after taking down, over a longer or shorter journey according to the group to which the needles belong; this variation of journey from one group to the other, having for its object to permit, or not, of the taking down and the release of the stitch formed in one of the preceding courses, the stitch when it is not taken down being kept in reserve on the needle. Members are also provided to supply the length of the thread necessary for forming the collars diagonally connecting the knotting stitches; those members may advantageously, according to the present invention, be formed by sinkers with projections raised so that in taking up, a supplementary length of thread may be taken off from the thread guide; these special sinkers which have to work conjointly alternately with the even numbered and the odd numbered needles are distributed in their guide by means of a special sinker in two grooves, so that they alternate with the ordinary sinker, a cam controlled at the right moment, that is to say every other turn, sets in action these special sinkers, whilst a series of cams acts on the jacks to bring them to the position desired for selecting the needles.

The invention is illustrated in the accompanying drawings, wherein:

Figs. 1 and 2 show unladderable knitted fabric which is the subject of the invention, seen on the right side and the wrong side respectively;

Fig. 3 is a partial vertical section of a circular machine arranged with a view to allowing the formation of the unladderable knitted fabric;

Fig. 4 is a partial view analogous to Fig. 3 and shows a special sinker made for the formation of unladderable knitted fabric;

Fig. 5 is a plan corresponding to Fig. 3 and shows in particular the cam groove traversed by the butts of the sinkers;

Fig. 6 is a partial section showing the arrangement of a jack differing from that which Fig. 3 shows;

Fig. 7 shows the control arrangement of a cam provided to act on the butt of a special sinker;

Fig. 8 shows in perspective view the mechanism for controlling the jacks;

Figs. 9 to 12 are diagrammatic views illustrating the operation of special sinkers;

Fig. 13 is a diagrammatic plan view of the cylinder of a circular machine and it shows the different zones of action of the needles;

Fig. 14 is a developed view of the cylinder showing, for each of the zones indicated in Fig. 13, the position of needles and of their control jack;

Fig. 15 is a view analogous to Fig. 14 and shows the position of the needles and of their control jack after the cylinder has accomplished a revolution of 360°, that is to say when the cylinder performs the second course of knitting;

Figs. 16 and 17 correspond to the third and fourth courses respectively;

Fig. 18 shows, side by side and in front elevation, for each of them, the members forming the cams;

Figs. 19 to 34 are diagrammatic views illustrating the formation of the unladderable knitted fabric; this formation taking place in four successive courses of stitching; Figs. 19 to 22 correspond to the first course;

Figs. 23 to 26 second course, and

Figs. 27 to 30 to the third course and lastly Figs. 31 to 34 to the fourth course;

Fig. 35 shows, seen on the wrong side, the unladderable knitted fabric formed according to the modification of the present invention;

Fig. 36 is a view analogous to Fig. 18 and shows the members of the cam modified to allow of manufacture of the knitted fabric illustrated in Fig. 35;

Figs. 37 to 41 are diagrammatic views showing how the production of knitted fabric illustrated in Fig. 35 takes place. (Fig. 37 corresponds to Fig. 26; Fig. 38 to Fig. 28; Fig. 39 to Fig. 30; Fig. 40 to Fig. 32 and Fig. 41 to Fig. 34.)

In the preferred embodiment shown in Fig. 1, right side and Fig. 2, wrong side, as well as in the variant of embodiment shown on Fig. 35, the knitting is composed of horizontal rows of loops r_1, r_2, r_3, r_4 , which have appreciably the same height and are connected to each other in parallel vertical rows f_1, f_2, f_3, f_4, f_5 . If one considers, for example, row r_3 , one sees that in this row the second loop represented beginning on the right side of Fig. 1, is united to the corresponding loop of the preceding row r_2 , by ordinary interlooping with the meshes as shown at l . The same is true for the fourth loop of this row, then for the sixth, etc.

The first loop of the said row r_3 is united with the corresponding loop of the preceding row r_2 , by knotting of two strands of the thread, in addition to the threads of the said loops themselves. One of these strands is made up of the rectilinear element z , which extends from the second loop of the said row r_3 to the loop not drawn which would be to the right of Fig. 1, on the said row r_3 and in the line preceding the line f_1 . The other strand of thread y is placed between the row r_3 and the preceding row r_2 and it runs zig-zag between these two rows from one point of knotting to the other, while forming, in the preceding row r_2 , the loops which are united at l by simple interlooping, as has been mentioned above, to the loops of the row under consideration r_3 . In a similar

manner, the third loop of the row r_3 is united with the corresponding loop of the preceding row r_2 , by knotting of two strands of thread in addition to the threads of the said loops themselves; one of these strands z being the rectilinear element which extends between the second loop and the fourth loop of the row r_3 , united with each other by simple interlooping at l to the corresponding loops of the preceding row r_2 ; the other strand of the knotted thread being the strand y ; running zig-zag, as has been mentioned, between the row r_3 and the row r_2 . The fifth loop of the row r_3 is united in the same manner to the corresponding loop of the preceding row r_2 , and so forth.

Thus, in one row the loops are connected to the loops of the preceding row and likewise to those of the following row, sometimes by simple meshing, at other times by the indicated knotting. The same sequence is found in the loops of each of the vertical rows f_1, f_2, f_3 , etc.

It may be seen that the rectilinear elements, such as z of the various rows are parallel to each other and that the loops of meshes are appreciably of the same height which gives the knitting an appearance which differs little from that of knitting with customary meshes, the said knitting being, besides, formed by a single thread without introducing supplementary weft thread, as in certain known knittings which, by reason of this weft thread, are given a relatively coarse appearance.

The variant of Fig. 35 differs from the embodiment of Figs. 1 and 2 only in the manner of intertwining of the threads z and y at the points of knotting of the loops.

There are shown in Fig. 3 the characteristic members of a circular knitting machine, that is to say at 1 the cylinder provided with tricks 2 in which the needles 3 may slide, vertically. The latter are guided furthermore by a plate 4 disposed in the upper part of the cylinder 1. The needles 3 are of the latch or "self-acting" type and comprise at their lower end a butt 5 engaged in a groove 6 machined in the inner periphery of the cam ring 7. The cam groove 6 is generally so shaped as to constitute a knitting cam 8 giving rise to the casting off or taking down of the thread; this cam groove is provided with a second or auxiliary cam 9, producing the rise of the needle to pass the stitch under the latch 3a.

According to the present invention, the cam 9 is so modified that the stitch to be cast off or taken down rests on the body of the latch and there are added to the cam ring 7 two cam grooves 10 and 11 intended to ensure the vertical translation of the jacks 12 and 13 (Fig. 6) arranged in the tricks 2 of the cylinder 1, below the butt 5 of the needles, the jacks 12 and 13 being arranged alternately in the needle tricks 2. The jacks 12 are provided with a butt 14 engaged in the groove 10 and the jacks 13 with a butt 15 engaged in the groove 11.

The annular flange of plate 4 is provided alternately with an ordinary sinker 16 (Fig. 3) and with a special sinker 17 (Fig. 4). The respective butts 16a and 17a of the sinkers are engaged in the cam groove 18 of the sinker cam ring 19, but as is to be seen in Figs. 3 and 4, the butt 17a of the special sinker 17 is higher than that of the butt 16a of the usual sinker 16. Because of this, the butt 17a may, besides the action that it receives from the groove 18, be subjected to the action of a supplementary cam 20 (Figs. 4 and 5).

This cam is pivoted at 21 on the sinker cam 19 and is subjected to the action of a return spring 22, keeping the cam 20 away from the internal edge 18a of the groove 18. The cam 20 may be made to approach the edge 18a by a pusher 23 acting on an extension 24 of the cam 20 according to the direction of the arrow *f*. The extension 24 comprises an adjustable abutment constituted, for example, by a little disc 25 eccentric relative to its fixing-screw 26. By its engagement with the periphery of the sinker cam ring 19 the disc 25 limits the angular displacement of the cam 20 and it will be understood that in modifying the angular position of the disc 25 relative to the extension 24 there may be obtained a longer or shorter stroke of the cam 20.

The pusher 23 is connected by its other extremity to a pivoting lever 27 (Fig. 7) subjected to the action of a return spring 28. At the opposite extremity to that at which the pusher 23 is hinged, the pivoted lever 27 is provided with a head 29 adjustable as to position. This head 29 is pressed in the field of action of the two upstanding cams 30 diametrically opposed on a plate 31 rotated so as to effect a complete revolution whilst the cylinder performs four revolutions; every two revolutions the pusher 23 acts on the extension 24 and pushes the cam 20 towards the wall 18a of the groove 18.

The special sinkers illustrated in Fig. 4 comprise a nose 17b raised relative to the nose 16b of the ordinary sinker 16.

In order to understand how unladderable knitting is obtained in accordance with the first manner of manufacture, reference will now be made to Fig. 14 which illustrates the grooves 10 and 11 comprising slopes 32 and 33; at the top of the slopes 32 and 33 are disposed two movable triangular guide cams 34 and 35; each may occupy, as to height, three different positions, that is to say: a high position (as is the case with the cam 35 in Fig. 14), a medial position (as is the case with the cam 34 in Fig. 15), and a low position (as is the case with cam 34 in Fig. 14). To this end, the cams 34 and 35 are rigidly connected to slides 36 and 37 respectively (see Figs. 8 and 18). These slides may be displaced individually and vertically by pivoted levers 38 and 39 of which the extremities 40 and 41 are subjected to the action of cams 42, 43. Each of these cams comprises three series of identical levels (Fig. 18) that is to say: a level 42a or 43a for which the corresponding cam 34 or 35 occupies the low position, a level 42b or 43b for which the corresponding cam 34 or 35 occupies the medial position, and lastly a level 42c or 43c for which the cam 34 or 35 occupy the high position. As will be seen from Fig. 18, the cams 42 and 43 are shifted one relative to the other so that to one of the levels 42a there corresponds a level 43c.

On the common shaft 44 of the cams is keyed a ratchet wheel 45 comprising twelve teeth and which may be angularly displaced by one tooth at each impulse of pawl 46. This pawl is carried by an operating lever 47 (Fig. 8) controlled by a rod 48 comprising at its lower extremity a runner 49; the runner 49 rolls on a cam 50 integral with a spindle 51 revolving at the same velocity as cylinder 1. Under these conditions, at each revolution of the cylinder 1, the cams 42 and 43 undergo an angular displacement such that, for the level in contact with extremity 40, 41 of the lever 38, 39, is substituted the following level; thus at each revolution of the cylinder 1 the cams 34 and 35 are vertically displaced. It is to be noted that

the levels 42c and 43c extend over an arc double the arcs corresponding to the other levels. The consequence is that after two consecutive translations, the cams 34 and 35 are motionless during two consecutive revolutions of the cylinder 1, in spite of the rotation of shaft 44.

Referring to Fig. 13, it will be seen that the needle cylinder is divided into four successive regions: viz. a region α which is to be found on Fig. 14 and which extends from the point wherein is effected the taking-up or drawing, to the point wherein is effected the taking down or casting off a region β which corresponds to the rising of the needle after casting-off, a region γ to which no vertical displacement of the needles corresponds, and a region δ in which the needles, after having been subjected to the action of the jacks 12, 13 of which the butts 14, 15 ride in grooves 10, 11 are divided into two groups at different heights, a needle of one group alternating with a needle of the other group. The needles a are controlled by the jacks 12 and the needles b by the jacks 13.

In order to understand clearly how the successive intertwining of threads are effected the working of the needles in the first row (Fig. 14) will be considered with reference to diagrammatic Figs. 19 to 22.

As has been said above, the needles, before the taking up are divided into two groups, the needles of one of these groups being at a definite height relative to the sinkers and those of the other group occupying a lower position. The needles of the first group will be called even needles and those of the second group odd needles, it being understood that the even needles alternate with the odd needles.

The even needles have affixed to them the reference a and the odd needles the reference b .

In the first course (Fig. 14), the even needles a are presented for taking up in the high position, their tops being on line H of Figs. 14, 19 and 22. The odd needles b are presented in the middle position (line M). The needles a and b take up the thread x distributed by the usual thread-guide. In the part α of the circular path, the needles are displaced vertically towards the bottom in the tricks 2 of the cylinder 1 by the action of knitting cam 8 (Fig. 3) which produces the taking down (Fig. 20), then, in the region β , the needles a and b rise without reaching the line B (Figs. 14 and 21) defining the low position. The needles, all aligned at the same height, traverse the region γ ; towards the end of the latter, the needles are subject to the action of the jacks 12 and 13, the needles a being controlled by the jacks 12 and the needles b by the jacks 13 which are guided, as has been described, by the groove 11.

At the middle of the slope 33, the jacks 13 meet the movable guide cam 35, which projects into the groove 11; they are thus raised and push the needles b to bring them into the high position. On the contrary, the movable guide cam 34 of the groove 10, in which the butts of the jacks 12 move is in a lowered position so that the jacks 12 guided only by the groove 10 are lowered so that the needles a are brought into the low position for which the stitch formed by the thread x on the taking down, rests on the latch a_1 (Fig. 22).

The needles thus distributed to two different heights traverse the region δ and arrive facing the thread guide for the second course of knitting. This thread, although it is the prolongation of the thread x distributed in the first course, will

be indicated by the reference γ and illustrated differently, to facilitate the comprehension of the formation of stitches (Figs. 15 and 23 to 26).

On taking-up (Fig. 23), the needles a are presented in the low position and the needles b in the high position.

These two groups of needles take up the thread y and, at this moment, the special sinkers 17 displaced by the action of the cam 20, receive an advance movement towards the center of the machine. They thus pass from the position indicated in Fig. 12 to the position illustrated in Fig. 9 which shows the position of a sinker 17 relative to one of its neighboring needles at the moment of taking up. Consequent on the raised position of the nose 17b relative to the nose of the sinker 16, the needles a , in the course of their descent, draw a greater length of thread than that drawn at the preceding course when the sinkers were in a non-advanced position. When the needles are descending (Fig. 24), no stitch is cast-off the needles a because the stitch formed with the thread x in the first course has been during this descent, entrapped under the hook of the needle by the turning up of the latch a_1 on which the said stitch rests as is shown in Fig. 22. On the other hand on the descent, a usual knitting stitch is obtained on the needles b .

On the needles rising and during the traverse of region γ (Fig. 25), the stitch formed by the thread x and the elongated stitch formed by the thread y which has been taken up more deeply than the thread x at the preceding course are located between the latch a_1 and the hook of the needles a . The unelongated stitch formed by the thread y on the needles b is located between the latch b_1 and the hook of the needles b .

At the beginning of region δ , the needles are subjected to the action of jacks which are appropriate to them. On reference to Fig. 15, it will be seen that the movable guide cam 34, associated with the groove 10 controlling the jacks 12 corresponding to the needles a , is passed from the lowered position which it occupied during the formation of the preceding course (Fig. 14) to the middle position indicated in Fig. 15; because of this, the needles a are raised and pass from the low position which they occupy before taking up to the middle position (line M) as is to be seen in Figs. 15 and 26. The movable guide cam 35 associated with the groove 11 controlling the jacks 13 corresponding to needles b has remained in the high position so that the needles b again take up the high position which they occupied before taking up; in this position (Fig. 26) the unelongated stitch formed by the thread y is located on the needle below the latch b_1 , the elongated stitch formed on the needle a by the thread y remaining on the latch a_1 whilst the unelongated stitch formed by the thread x in the first course passes below the said latch a_1 , because of the rise of the needle limited to the middle position. It may be remarked that because of the advance movement of the sinkers 17 towards the center of the machine after the action of the jacks, the noses or projections 17b of the sinkers 17 have penetrated between the unelongated stitch formed by the thread x and the elongated stitch constituted by the thread y (Fig. 10). This penetration thus effects the separation of the unelongated and elongated stitches.

The third course of knitting is now going to be effected. Before taking up, the needles a are presented in middle position whilst the needles b are in high position. The prolongation of the

thread x , which will be designated by z in Figs. 16 and 27 to 30, corresponding to the third course, is taken-up by the needles a and b (Fig. 27). Before taking up, the cam 20 has been brought to the position which it had when the first course was formed. The sinkers 17 are thus brought back to their rear position and the length of the thread z taken up by each needle, is the same as that of the thread x at the first course. Thereafter the needles take down (Fig. 28). In the course of this taking down the unelongated stitch produced by the thread y on the needles b forms an unelongated stitch with the thread z whilst the unelongated stitch formed by the thread x at the first course on the needles a , grips and stitches the elongated stitch formed by the thread y as well as the thread z .

The assemblage of the needles again rises as shown in Fig. 29. They effect their traverse in the region γ and arrive at the point where they are subjected to the action of the jacks. The movable guide cam 34 associated with the needles a , is passed from the middle position which it occupied in Fig. 15 to the high position in Fig. 16. Because of this, the needles a are raised by their jacks and brought to the high position (Fig. 30). The movable guide cam 35 controlling the jacks 13 and, in consequence, the needles b , has been lowered from the high position which it occupies in Fig. 15 to the low position indicated in Fig. 16; the needles b are thus brought to the low position. It follows that the unelongated stitch formed from the taking down on the needles b with the thread z rests on the latch b_1 , whilst the stitches formed by the thread y and by the thread z passes below the latches a_1 of the needles a (Fig. 30).

The needles then start the fourth course by taking up the thread v (prolongation of the thread x); before taking up, the needles a are in the high position, and the needles b are in the low position (Figs. 17 and 31). Starting with the taking down, the stitches formed by the thread x and the thread y , grip the thread v on the needles a as is illustrated in Fig. 32, whilst the stitch formed by the thread z on the needles b rests enclosed between the needle hook and the latch b_1 . At the moment of the taking down, the cam 20 has started the advance of the sinker 17 so that on taking up, the needles have formed with the thread v (consequent on the presence of the projections on the sinkers 17) elongated stitches analogous to the stitches formed in the second course by the thread y . The needles rise and traverse the region γ during this traverse the threads are presented as shown in Fig. 33. The needles thus arrive at the point where they are subjected to the action of the jacks. Referring to Fig. 17, it will be seen that the movable guide cam 34 has not undergone vertical displacement; it remains at the high position indicated in Figs. 16 and 17. On the other hand the movable guide cam 35 has been displaced upwards and has passed from the low position indicated in Fig. 16 to the middle position indicated in Fig. 17. Consequently the needles a , operated by the movable guide cam 34, are brought back to the high position whilst the needles b controlled by the movable guide cam 35 leave the middle position as illustrated in Fig. 33. Fig. 34 shows the knitting obtained when the four courses of the cycle have been carried out. In Figs. 1 and 2, the knitting is supposed to have received a certain lateral tension, similar to the tension which is exerted when the knitting is

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worn by the user. Because of this lateral tension, the intertwining shown in Fig. 34 is deformed, the looped parts are reabsorbed through the preceding looped part b_3 and the knitting takes the appearance shown in Figs. 1 and 2. The cycle being terminated, the needles a and b are presented for taking up for a new cycle in the position which they occupied in Fig. 14 and in Fig. 19; the needles a are then in the high position whilst the needles b are in the middle position (Fig. 33).

According to a modification of construction, the even and odd needles may no longer occupy three positions differing in height, but only two positions: the high position and the low position.

In this the cams 42 and 43 employed in the first method of manufacture are modified as illustrated in Fig. 36. Each of the cams 42' and 43' comprises no more than two series of levels, that is to say the levels 42'a and 43'a corresponding to the low position, and the levels 42'c and 43'c corresponding to the high position. Under these conditions, the movable guide cams 34 and 35 are brought either to the high position, as illustrated in Figs. 16 and 17 for the guide cam 34 and to the Figs. 14 and 15 for the guide cam 35, or to the low position Fig. 14 for guide cam 34 and Fig. 16 for guide cam 35. The middle position indicated in Fig. 15 for the guide cam 34 and in Fig. 17 for the guide cam 35 are replaced by the high positions.

In the first course the even and odd needles are presented in the high position. They operate as has been previously described and the intertwining of the thread is shown with reference to Figs. 19 and 22.

In the second course, the taking up and the taking down are effected as has been previously described, but during the traverse of region δ , the needles a are brought again to the high position (line H, Fig. 37, in the place of being brought to the middle position line M Fig. 26). Because of this the elongated stitch formed on the needles a by the thread y passes, together with the stitch formed by the thread x , under the latch a_1 .

In the third course the needles a and b are presented in the high position. The needles take down, Fig. 38.

The needles a at the entrance to the region δ are raised by their jacks and are brought to the high position, line H Fig. 39. The needles b under the action of their jacks are brought to the low position, the unelongated stitch formed, starting from the taking down on the needles b with thread z remains on the latch b_1 , whilst the elongated stitch formed by the thread y as well as the unelongated stitch formed by the thread z on the needles a , passes below the latch a_1 of the needles a .

The needles begin the fourth course in the position indicated in Fig. 39. Starting from the taking down the unelongated stitch formed by the thread x and the elongated stitch formed by the thread y grip the thread v as illustrated in Fig. 40.

The needles a and b rise to the high position and traverse the zone δ . The cycle is terminated and the needles a and b all presented for a new cycle in the high position as shown in Fig. 41

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where it is to be seen that the thread v doubles the stitch formed by the thread z . Assuming as previously that the knitting is subjected to lateral tension, it is easy to understand that the intertwining shown in Fig. 41 is deformed and that the stitch formed by the thread v is reabsorbed and doubles the stitch formed by the thread z . The intertwining has then the arrangement shown in Fig. 35.

I claim:

1. Unladderable knitted fabric formed by a single thread constituting unelongated stitches and elongated stitches having substantially the same height as the unelongated stitches and the unelongated stitches occurring alternately with the elongated stitches in each course and in each line so that, from one course to the other, the unelongated stitches and the elongated stitches are in quincunx and that in each course, the elongated stitches are looped by the unelongated stitches of the preceding course, the said elongated stitches being in intertwining relation with the loops of thread connecting the elongated stitches formed in the preceding course and with the rectilinear elements of thread connecting the successive unelongated stitches in the course considered, the said rectilinear elements of the various courses being substantially parallel to each other while the looped parts of the thread comprised between two elongated stitches of two successive courses are disposed diagonally.

2. Unladderable knitted fabric formed by a single thread constituting the unelongated stitches and elongated stitches having substantially the same height as the unelongated stitches and said unelongated stitches occurring alternately with the elongated stitches in each course and in each line so that, from one course to another, the unelongated stitches and the elongated stitches are disposed in quincunx and that in each course the elongated stitches are looped by the unelongated stitches of the preceding course, the said elongated stitches being in intertwining relation with the rectilinear thread elements uniting the two unelongated stitches which are disposed in the same course on both sides of the elongated stitches and with the intermediate thread elements uniting two elongated stitches of the preceding course so that the said intermediate elements are disposed diagonally.

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