Jan. 18, 1955 P. N. PETERS 2,699,658

METHOD OF AND MACHINE FOR WARP KNITTING

Filed May 3, 1952

FIG. 1

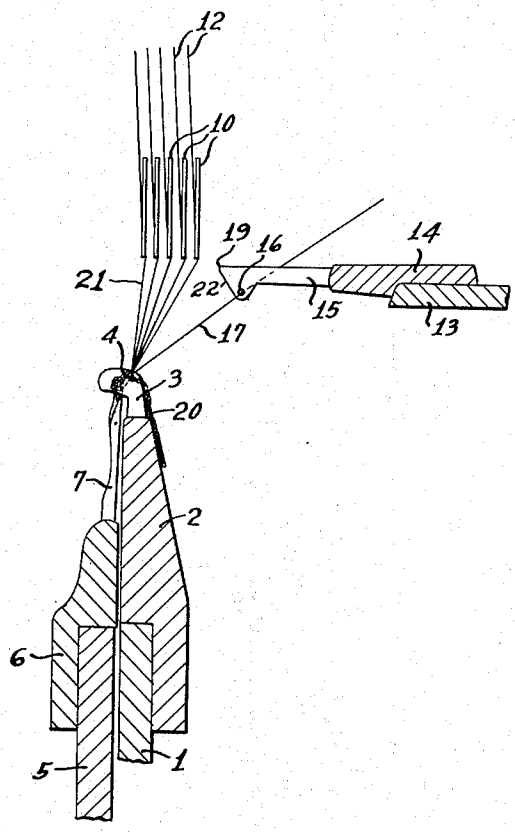


FIG. 2

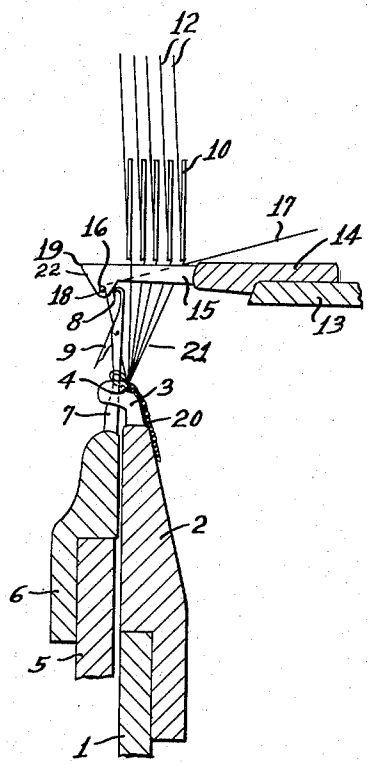
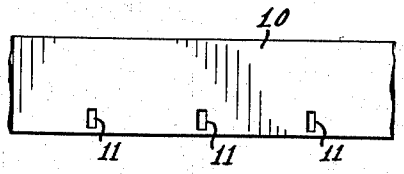


FIG. 3



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METHOD OF AND MACHINE FOR WARP KNITTING

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24 Claims. (Cl. 66—84)

This invention relates to improvements in methods of and apparatus for warp knitting and is particularly although not exclusively concerned with warp knitting of open mesh and ornamental fabrics such as laces.

Warp knitting of ornamental and open mesh fabrics is done today mostly on Raschel machines. The knitting mechanism of the Raschel machine in its simplest form consists of the following: a row of latch needles is mounted for vertical reciprocation in a comb or "trick plate," the needles being cast in lead blocks mounted on a cam-actuated needle bar which moves up and down, with a suitable dwell in the top position. A guide bar assembly is pivotally mounted above the needles. This assembly consists of a plurality of bars each of which carries a row of guides cast in lead blocks each guide having a thread guiding eye at its lower end. These guides are designed to swing through the row of needles, and each guide must, therefore, be made very thin in order to pass between two adjacent needles. The outside row of guides, i. e. the one farthest from the needles when the guide bar assembly is positioned in front of the latter, is called the "front" or the stitching guide bar, the others being the "back" or the inlay guide bars.

The Raschel knitting cycle can be briefly described as follows: While all guide bars, with their guides properly threaded with yarn or "ends," are in front of the needles, they are shogged, that is moved longitudinally with respect to the row of needles, in accordance with some predetermined pattern. By the time this shogging action has been completed, the needles will have been raised to their topmost position, whereupon the entire guide bar assembly swings toward the needles, all guides passing through the needles, that is through the row of needles, the tip of each individual guide passing between two adjacent needles. When all guides have been swung to the back of the needles, that is to say, to the hook side, the stitching bar, that is the one now nearest to the needles, shogs again, usually through the space of one needle, thus laying the guided stitching ends across the adjacent needles and under their hooks. After the stitching bar completes its shog in the back of the needles, the entire guide bar assembly is swung back through the waiting needles, to its original position in front of the latter. As soon as all guides clear the needles on their return swing, the needles descend with the new loops under their hooks. Each old previously formed loop comes in contact with the latch of its descending needle and closes it, allowing the closed hook with the new loop in it to be pulled through the old loop, whereupon the latter slides off the needle and is cast off as a part of a course in the newly formed fabric.

At the beginning of the next cycle, when the needles begin to ascend, each newly formed loop which is still under the hook, is held down by the fabric, or rather by the previously formed and cast off stitch, and, not being allowed to rise with the needle as the latter ascends, forces the latch open, the latter sliding through the loop and clearing it when the needle reaches the topmost position. Meanwhile, the guides will have again swung through the needles, and the entire cycle is repeated.

All guides, as well as the ends threaded through them, are divided into two basic groups: the stitching guides with their "stitching ends," and the inlay guides with their "inlay ends." The inlay guides shog only when they are in front of the needles: thus the inlay ends, or inlays, remain unknitted. The other guides, the stitching guides, are adapted to shog both in front of and in the back of

the needles, thus being able to place their ends under the needle hooks, to form stitches. Because the inlay guides shog while they are between the stitching guides and the needles, the loops formed by the stitching ends on the needle hooks overlap, pull down and anchor all horizontal or shogged sections of the inlay ends, thus forming a knitted fabric the structure of which obviously depends on various movements of both the inlay and the stitching bars as these are controlled by pattern chains.

Although the Raschel machine is one of the most versatile knitting machines in existence, it is not feasible to operate it with more than six separate guide bars, although it would be highly desirable to use more. Indeed, ever since warp knitting machines came into existence, repeated attempts have been made to increase their versatility and output by increasing the number of guide bars without any loss in operating speed.

In the past, these attempts have not fared particularly well; warp knitting machines in which the inlay bar or bars swung either with or over the stitching guides could accommodate only a few additional bars and had enough design shortcomings to limit their potentialities. Much greater promise was shown at one time by machines in which the swinging inlay bars were done away with entirely, being replaced by non-swinging steel strip guide bars characteristic of the Leavers lace machine. Unfortunately, whatever advantages might have resulted from the elimination of the swinging inlay bars, have been lost, because all inventors who have adopted non-swinging inlay bars have found it necessary to provide auxiliary elements charged either (1) with the task of selecting, combing and holding the shogged inlays so that the latter could be accurately stitched in place, or (2) with the task of shogging, the stitching ends. Since the first of these auxiliary elements has to do all its work after the inlays have completed their shog and before the stitching guide could resume its advance, and since the second must operate after the stitching guide has pierced both the inlay curtain and the plane of the needles, the time intervals for the operation of these auxiliary elements had to be squeezed into the already crowded and barely adequate knitting cycle. As the result, all multibar machines of this design had to be slowed down to a pace at which their operation was neither profitable nor practical. There is no indication that any of the warp knitting machines equipped with non-swinging inlay bars and the concomitant auxiliary elements have ever been commercially successful.

It is the object of the present invention to improve the construction and operation of warp knitting machines particularly, of the Raschel type, by retaining the principal advantages of the non-swinging inlay bar assembly and at the same time eliminating the auxiliary elements the use of which, however detrimental, was deemed essential in the past. I have attained this result by manipulating the stitching guides in a manner—new in the art—which enables them to take over all the functions which heretofore have been performed by the auxiliary elements. It is, primarily this novel use of the stitching guides as the single means for entering, selecting, piercing, combing and, in cooperation with the needles, stitching in the shogged portions of the inlays that differentiates this invention from all structures and methods disclosed in the prior art. By dispensing with both the swinging inlay guide bar assembly and the formerly concomitant auxiliary members, that is by drastically reducing the number of moving parts and by simplifying their action, my invention makes it possible to operate a warp knitting machine with any reasonable number of inlay bars, at speeds now thought possible only on a single bar machine.

In my machine, the inlay bars do not swing but are mounted a fixed distance in front of the needles. Hence, the inlay ends never pass through the needles, and can neither hook in nor become chafed. After shogging, the inlay ends are selected or, rather, selectively separated and held in their shogged positions by the stitching guides and the stitching ends as these enter and pass through the curtain of shogged inlays and through the row of needles. When the thread-guiding eyes of the stitching guides carrying the bights of the stitching ends

are in back of the needles, the guides shog the bights to lay the stitching ends under the needle hooks; thereupon the stitching guides are retracted, and the needles descend to form the stitch.

In the accompanying drawings I have illustrated diagrammatically the essential operating mechanism of a warp knitting machine constructed in accordance with my invention and capable of carrying out its method. In these drawings,

Figure 1 is a vertical transverse section showing the needle bar in its lowermost position and the stitching guide bar in its extreme retracted position in which the tips of the stitching guides are completely withdrawn from the curtain of inlays;

Figure 2 is a similar view showing the machine with the needle bar in its uppermost position and the stitching guide bar in its most advanced position, with the stitching guides extending through the inlay curtain and the stitching ends passing between the needles, and

Figure 3 is an elevation of a section of one of the inlay bars.

In these drawings, **1** indicates the fixed sinker bar or "trick plate" on which are mounted lead blocks **2** in which the sinkers or combs **3** are cast. These sinkers are provided with a transverse rod **4** or its equivalent which serves to knock over the loops as these are formed. Mounted for vertical reciprocation, by means not shown, adjacent the sinker bar **1** is the needle bar **5** on which are mounted lead blocks **6** in which a row of latch needles **7** are cast, each provided with the usual hook **8** and latch **9**. Mounted above the sinkers **3** and in front of the needles **7** are a plurality of inlay bars or inlay guide bars **10**, each provided with a plurality of thread-guiding eyes **11** through which pass the inlay ends **12**. These inlay bars do not swing transversely but are shifted or shogged in a direction parallel to their lengths (that is, at right angles to the plane of the paper) in accordance with a predetermined pattern, by pattern chains not illustrated. The inlay guide bars may be either of the standard Raschel construction—except that they do not swing—or, as illustrated, they may be patterned after the thin steel strip guide bars, approximately .004–.006 of an inch thick, characteristic of the Leavers lace machine. Beyond the inlay bars away from the needles i. e. on the front side of the latter, is mounted the stitching guide bar **13** on which are mounted lead blocks **14**, in which a row of stitching guides **15** are cast. These stitching guides are thin steel plates, the thickness of which varies with the gauge of the machine. Each stitching guide is provided near its forward end with a thread-guiding eye **16** through which passes the stitching end **17** forming a bight **18**. The forward ends of the stitching guides are pointed and slanted as shown to form a tip **19** and a continuous, unbroken, rearwardly slanting leading edge **22**, so as not to catch upon the inlays but comb them down as the stitching guide bar is reciprocated horizontally, either in a straight line or in a curved path, by suitable means, not shown. The inlay ends **12** and the stitching ends **17** after passing through their respective guiding eyes **11** and **16** are led to the upper edge of the fabric **20**.

The machine just described operates as follows: At the stage of the knitting cycle shown on Figure 1, the needles **7** are down in the trick plates **3**, and the stitching guides **15** are in front of the needles, their tips completely clearing the curtain **21** of inlay ends which extend between the lower edges of the inlay bars and the fabric. The inlay ends are shogged in accordance with some predetermined pattern while the stitching guide bar waits and the needles resume their ascent.

As soon as the shog of the inlays is complete, the stitching guides advance; their tips enter the curtain of shogged inlays, preferably, close to the inlay guides **10**, thus selecting or, rather, selectively separating the shogged inlays, piercing and combing them down, so that finally the entire shogged portion of each inlay end becomes contained below the stitching bight, the bight overlapping the shogged portion of the inlay. The stitching guides advance through the curtain of inlays carrying the stitching bights through the curtain as well as through the row of needles which, by this time, will have come up to their topmost position. As soon as their bight-carrying eyes clear the needles the stitching guides shog back of the latter, laying the stitching ends under the adjacent needle hooks **8** (Figure 2) and at the same time deflecting the inlay ends contained between the shogging stitching guides; whereupon the stitching guides withdraw to their starting position (Figure 1) while the needle bar descends, the previously formed loops closing the latches and being knocked over by the rod **4**, to form the next course in fabric **20**.

In my machine, the inlay bars may begin their shogging action preparatory to the next stitch while the stitching guides are still within the curtain of inlays—even during the inward movement of the guides—and it is not at all necessary that shogging be delayed until the stitching guides have completely cleared the inlays. For as long as the stitching guides lie within the curtain of inlays, each inlay end being contained between two adjacent stitching guides, the inlays are divided by these guides into two portions, and either portion may be manipulated independently of the other. Thus while the shogged lower portion is being pulled down and stitched in by the stitching ends, the "unshogged" upper portion may start and leisurely complete its next shog. I say "leisurely" because such a shog need no longer take place within the conventional limits of, approximately, 35% of the knitting cycle (the interval customarily allotted to the inlay shog), but may be spread over almost 100% of said cycle, the sole requirement of the new timing being that the shog be completed before the tips of the stitching guides re-enter the curtain of inlays on their next passage towards the needles. In practice, the inlay shog may end somewhat sooner, i. e. somewhat before the tips of the stitching guides are withdrawn from the curtain of inlays, whereupon the latter, being under tension, snap into their newly shogged position, ready to be selected, pierced and combed by the stitching guides as soon as the latter begin their next movement towards the needles. The almost trebled time interval thus made available for the inlay shog enables the inlays to make longer and yet slower shogs, resulting in a much smoother action of the machine and fewer broken ends caused by jerky inlay feeds attributable to long and fast shogging.

I claim:

1. The method of warp knitting which comprises shogging inlay ends, passing the bights of stitching ends through the curtain of shogged inlay ends to overlap the shogged portions of the latter, and then shogging said bights in the back of the needles to stitch in the overlapped portions of the inlays.

2. The method of warp knitting which comprises passing stitching ends through a curtain of shogged inlay ends to hold them in their shogged position, stitching the inlay ends in their shogged position, shogging the inlay ends and then withdrawing the stitching ends from the inlay curtain.

3. The method of warp knitting with threaded inlay bars and stitching guides and reciprocable hooked needles, which comprises forming a curtain of inlay ends extending between the inlay bars and the fabric and interposed between the stitching guides and the front of the needles, containing each inlay end between two adjacent stitching guides by passing the stitching guides through the curtain of inlay ends, and shogging the inlay ends while they are contained between the stitching guides.

4. The method of warp knitting with threaded inlay bars and stitching guides and reciprocable hooked needles, which comprises forming a curtain of inlay ends extending between the inlay bars and the fabric and interposed between the stitching guides and the front of the needles, containing each inlay end between two adjacent stitching guides by passing the stitching guides through the curtain of inlay ends, shogging the inlay ends while they are contained between the stitching guides, withdrawing the stitching guides from the curtain of inlay ends, and snapping the inlay ends into their newly shogged position.

5. The method of warp knitting which comprises shogging inlay ends, passing the bights of stitching ends through the curtain of shogged inlay ends to hold the latter in their shogged position, and then shogging said bights to stitch the inlay ends in their shogged position.

6. The method of warp knitting with inlay and stitching ends and reciprocable hooked needles which comprises shogging the inlay ends in front of the needles, passing the bights of the stitching ends through the curtain of shogged inlay ends and through the row of needles to hold the inlay ends in position for stitching, shogging the stitching guides to lay the stitching ends under the needle hooks and completing the stitch.

7. The method of warp knitting on a machine having a row of reciprocable hooked needles, which comprises shogging a curtain of inlay ends in front of the needles, passing stitching ends through the curtain of shogged inlay ends to hold the inlays in their shogged position, passing the stitching ends through the row of needles, and shogging the bights of said stitching ends to lay the latter under the needle hooks to stitch in the inlays.

8. The method of warp knitting with inlay and stitching ends and reciprocable hooked needles which comprises shogging the inlay ends in front of the needles, passing the bights of the stitching ends through the curtain of shogged inlay ends to overlap them in their shogged position, and then shogging said bights to stitch in the overlapped inlays.

9. The method of warp knitting with inlay and stitching ends and reciprocable hook means which comprises shogging the inlay ends horizontally in front of the needles where they always remain, holding the inlay ends in shogged position by passing the bights of the stitching ends through them and through the needles, and then shogging said bights to stitch the inlays in position.

10. A warp knitting machine comprising a needle bar equipped with hooked needles, an inlay bar threaded with inlay ends, means for shogging the inlay bar, and a single reciprocable means for selecting, piercing, combing and, in cooperation with the needles, stitching in the shogged portions of said inlays.

11. In a warp knitting machine having a row of reciprocable hooked needles, an inlay bar in front of the needles, the bar having a plurality of thread-guiding eyes through which inlay ends pass to form a curtain, and a row of stitching guides, each guide having a thread-guiding eye near its forward end through which a stitching end passes, the combination of means for passing the stitching guides through the curtain of inlay ends to contain each inlay end between two adjacent stitching guides, and means for shogging the inlay ends while they are contained between the stitching guides.

12. In a warp knitting machine having a row of reciprocable hooked needles, an inlay bar in front of the needles, the bar having a plurality of thread-guiding eyes through which inlay ends pass to form a curtain, and a row of stitching guides, each guide having a thread-guiding eye near its forward end through which a stitching end passes, the combination of means for passing the stitching guides through the curtain of inlay ends to contain each inlay end between two adjacent stitching guides, means for shogging the inlay ends while they are contained between the stitching guides, means for withdrawing the stitching guides from the curtain of inlay ends, and means for snapping the inlay ends into their newly shogged position.

13. A warp knitting machine comprising a row of hooked needles, an inlay bar in front of the row of needles, a row of stitching guides, each guide having a thread-guiding eye, means for shogging the inlay bar in a direction parallel to its length, means for reciprocating the needles, means for reciprocating the stitching guides from a position in front of the inlay bar and the needles to a position in which the eyes of the stitching guides are in back of the needles, and means for shogging the stitching guides when in the latter position.

14. A warp knitting machine comprising a row of vertical hooked needles, horizontal inlay bars in front of and parallel to the row of needles, a row of horizontal stitching guides at right angles to the needles, below the inlay bars, each having a thread-guiding eye near its forward end, means for shogging the inlay bars horizontally and parallel to the row of needles, means for vertically reciprocating the needles, means for horizontally reciprocating the stitching guides from a position in front of the inlay bars and the needles and under the inlay bars to a position in which the eyes of the stitching guides are in back of the needles, and means for shogging the stitching guides when in the latter position.

15. A warp knitting machine comprising a row of hooked needles, inlay bars in front of the needles, each bar having a plurality of thread-guiding eyes through which inlay ends pass to form a curtain, a row of stitching guides, each guide having a thread-guiding eye through which a stitching end passes, means for shogging the inlay bars, means for moving the stitching guides from a position in front of the inlay bars and the needles, and through the curtain of shogged inlay ends to a position in which the eyes of the stitching guides lie in back of the needles and the stitching ends pass through the row of needles to hold the shogged inlays in position, means for shogging the stitching guides to lay the stitching ends under the needle hooks, and means for lowering the needles to stitch the inlays in position.

16. A warp knitting machine comprising a row of vertical hooked needles, horizontal inlay bars in front of the needles, each bar having a plurality of thread-guiding eyes through which inlay ends pass to form a curtain, a row of horizontal stitching guides, each guide having a thread-guiding eye near its forward end through which a stitching end passes, means for shogging the inlay bars in a direction parallel to their lengths, means for moving the stitching guides from a position in front of the inlay bars and the needles, under the inlay bars and through the curtain of shogged inlay ends to a position in which the eyes of the stitching guides lie in back of the needles and the stitching ends pass through the row of needles to hold the shogged inlays in position, means for shogging the stitching guides in the latter position to lay the stitching ends under the needle hooks, means for lowering the needles to stitch the inlays in position, and means for returning the stitching guides to their original position, in which they clear the inlay curtain.

17. A warp knitting machine comprising a row of reciprocable hooked needles, an inlay bar in front of the needles and at a fixed distance from them, means for shogging the inlay bar in a direction parallel to the row of needles, a row of stitching guides, each guide having a thread-guiding eye, means for moving the stitching guides from a position in front of the inlay bar and the needles to a position in which the stitching guide eyes are in back of the needles, means for shogging the stitching guides in the latter position, and means for returning them to their original position.

18. A warp knitting machine comprising a row of reciprocable hooked needles, inlay bars in front of the needles and at a fixed distance from them, a plurality of thread-guiding eyes in the bars through which inlay ends pass to form a curtain, means for shogging the inlay bars in a direction parallel to the row of needles, a row of stitching guides, each guide having a thread-guiding eye, a stitching thread passing through each eye, means for moving the stitching guides from a position in front of the inlay bars and the needles and through the curtain of shogged inlay ends to a position in which the stitching guide eyes are in back of the needles and the stitching ends extend through the inlay curtain and the row of needles, means for shogging the stitching guides in the latter position to lay the stitching ends under the needle hooks, means for returning the stitching guides to their original position, and means for lowering the needles to stitch the shogged inlays in position.

19. In a warp knitting machine having a row of reciprocable hooked needles, the combination of an inlay bar in front of the needles, a row of stitching guides, each guide having a thread-guiding eye, means for shogging the inlay bar, means for moving the stitching guides from a position in front of the inlay bar and the needles and through the space between the inlay bar and the needles to a position in which the eyes of the stitching guides lie in back of the needles, and means for shogging the stitching guides to lay the stitching ends under the needles hooks.

20. In a warp knitting machine having a row of reciprocable hooked needles, the combination of an inlay bar in front of the needles, a row of stitching guides, each guide having a thread-guiding eye, means for shogging the inlay bar, means for moving the stitching guides from a position in front of the inlay bar and the needles to a position in which the eyes of the stitching guides lie in back of the needles, and means for shogging the stitching guides to lay the stitching ends under the needle hooks.

21. In a warp knitting machine having a row of reciprocable hooked needles, the combination of an inlay bar in front of the needles, the bar having a plurality of thread-guiding eyes through which inlay ends pass to form a curtain, a row of stitching guides, each guide having a thread-guiding eye near its forward end through which a stitching end passes, means for shogging the inlay bars, means for moving the stitching guides from a position beyond the inlay bars away from the needles, under the inlay bars and through the curtain of inlay ends to a position in which the eyes of the stitching guides lie in

back of the needles and the stitching ends pass through the row of needles, and means for shogging the stitching guides to lay the stitching ends under the needle hooks.

22. In a warp knitting machine having a row of hooked needles mounted for vertical reciprocation, the combination of horizontal inlay bars in front of and parallel to the needles, a row of stitching guides, each guide having a thread-guiding eye near its forward end, means for shogging the inlay bars in the direction of their length, means for reciprocating the stitching guides from a position beyond the inlay bars in front of the needles and under the inlay bars to a position in which the eyes of the stitching guides lie in back of the needles, and means for shogging the stitching guides to lay the stitching ends under the needle hooks.

23. A warp knitting machine comprising a needle bar equipped with hooked needles, an inlay bar threaded with inlay ends, means for shogging the inlay bar, and a single reciprocable means for selecting, piercing, combing and, in cooperation with the needles, stitching in the shogged portions of said inlays, said single reciprocable means comprising a stitching guide having a pointed entering tip and a continuous, unbroken, rearwardly slanting leading edge.

24. In a warp knitting machine having a row of reciprocable hooked needles, an inlay bar in front of the needles, the bar having a plurality of thread-guiding eyes through which inlay ends pass to form a curtain, and a row of stitching guides, each guide having a pointed entering tip and a continuous, unbroken, rearwardly slanting leading edge and having a thread-guiding eye near its forward end through which a stitching end passes, the combination of means for passing the stitching guides through the curtain of inlay ends to contain each inlay end between two adjacent stitching guides, and means for shogging the inlay ends while they are contained between the stitching guides.

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