

June 21, 1955

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2,711,092

METHOD OF AND MACHINE FOR WARP KNITTING

Filed July 5, 1952

2 Sheets-Sheet 1

FIG. 4

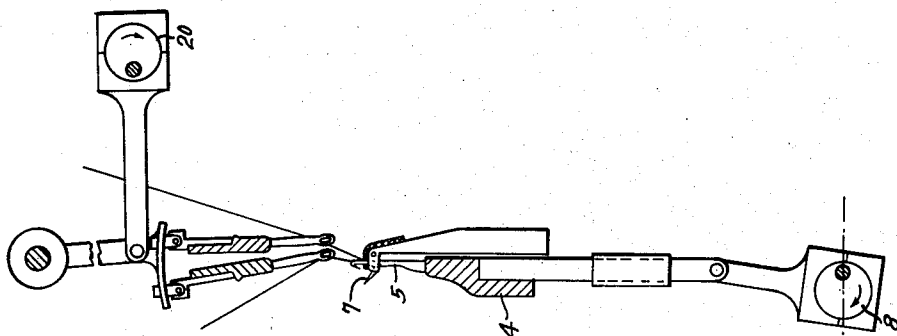


FIG. 3

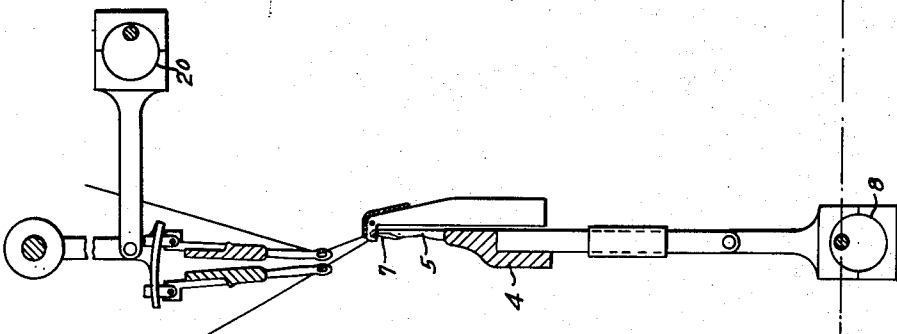


FIG. 2

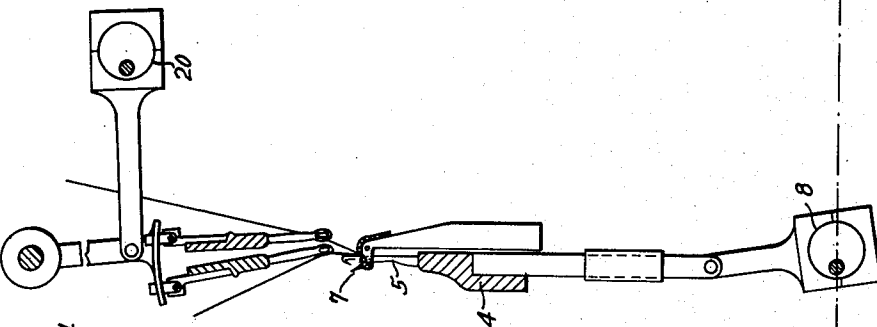
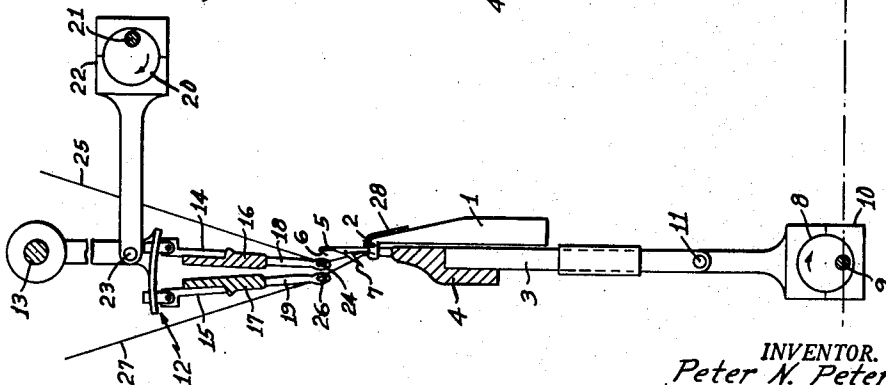


FIG. 1



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2,711,092

METHOD OF AND MACHINE FOR WARP KNITTING

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Application July 5, 1952, Serial No. 297,255

17 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 on machines of the Raschel and tricot type.

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 cam-actuated guide bar assembly is pivotally mounted for oscillation above the needles with a suitable dwell in the extreme position in front of 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 and the swing momentarily arrested, 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 to 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 swing 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, which have meanwhile remained stationary, 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

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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.

Ever since warp knitting machines came into existence, repeated attempts have been made to increase their operating speeds. At best, these attempts have been only partially successful because, in all of them, speed has been held down by what has become identified as the "standard warp knitting cycle." While some of the earlier experimenters may have recognized the fact that it was the principal characteristic of this very cycle—irregular motion due to the "start-stop-and-wait" action of the component elements—that was the real deterrent in so far as high speed operation of the machine was concerned, none of them appears to have succeeded in correcting the condition.

On a warp knitting machine of the conventional design, the swinging or, rather, oscillating guide bar assembly is at rest during some 35 to 45% of the entire cycle, waiting for the needles to make the stitch and then return to their topmost position. In turn, the needle bar must also remain stationary (in its topmost position) for about 33% of the cycle, waiting for the guide bar assembly to swing through the plane of the needles, both in and out. As the result of this series of dwells or intervals devoted to waiting, every component member of the warp knitting operating mechanism performs useful work only during one third to one half of the knitting cycle.

The limitation which this series of "start stop and dwell" sequences imposes on the machine is obvious: during every cycle, the component members (i. e., the needle bar and the guide bar assembly) must come to a full stop and remain stationary a certain substantial portion of the cycle; then they must rapidly accelerate, decelerate, reverse, accelerate, decelerate and then come to a full stop so as to perform their entire normal functions within but a small allotted fraction of the cycle. The resultant motion is necessarily non-uniform, irregular, unbalanced and tends to produce vibration and shock. It has to be controlled either by cams or by various equivalent mechanisms capable of simulating the desired cam action but incapable of achieving dynamic balance which is so essential to smooth operation at high speed. It is obvious that any attempt to increase the speed of any such conventional cam controlled and dynamically unbalanced warp knitting machine would reduce the already barely sufficient time interval allotted to the individual action of its components, calling for still faster starts and stops and thus increasing the shock and strain on such members to a point at which really high speed in a warp knitting machine of the conventional design must be regarded as unattainable or impracticable.

It is the object of the present invention to achieve

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high speed operation of a warp knitting machine by overcoming or eliminating the shortcomings attributable to the conventional "start-stop-and-wait" warp knitting cycle. I have attained this object basically by operating the components of the warp knitting mechanism in simple harmonic motion which eliminates dwells, provides uniform acceleration and deceleration, ensures a smooth reversal and makes it possible to achieve dynamic balance of the operating mechanism.

But simple harmonic motion without more is no panacea. For example: if only the needle bar is reciprocated in simple harmonic motion the needles will be continuously moving and may not remain near their uppermost position long enough to permit the thread guides to pass back and forth through them, and if the rearward swing of the guides is timed to pass them through the plane of the needles too long before the needles reach their uppermost position, the ends cannot be properly controlled. If the guide bar assembly, operated by the usual stop and start cam mechanism is speeded up to avoid this difficulty, the advantages gained from the simple harmonic motion of the needle bar are more than offset by the increased vibration and shock resulting from the increased speed of the guide bar assembly. If, on the other hand, the reciprocation of the needle bar is slowed to a point where the guides pass through the plane of the needles as the latter are about to reach their uppermost position, then no appreciable gain in speed will be had. So reciprocation of the needle bar in simple harmonic motion is not enough.

If now in addition to reciprocating the needle bar in simple harmonic motion the guide bar assembly is similarly reciprocated this, without more, will not solve the problem. A warp knitting machine so modified will not be able to stitch because the stitching guides will remain too long in the back of the needles. To make the modification operative, several other—by no means obvious—changes are necessary, such as: (a) greatly increased swing towards the front of the needles, (b) advance timing, (c) deeper setting of the guides. In fact, even with these changes, the machine would have only limited usefulness as it could be operated only with a single guide bar, producing fabric of doubtful quality, full of "damages" due to critical tensions.

It is to speed up the travel of the stitching guides in the back of the needles, without losing any of the advantages of simple harmonic motion, and without acquiring any of the disadvantages of the changes listed above that I developed my new warp knitting method.

In my invention (as applied to a Raschel warp knitting machine), both the needle bar and the guide bar assembly are reciprocated in simple harmonic motion, being driven by eccentrics, cranks or their equivalents, the rate of reciprocation of the guide bar assembly being greater than that of the needle bar, the guide bar eccentric being operated at some multiple of the speed of the needle bar eccentric, usually two, for reasons which are outlined in detail below.

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

Figure 1 is a vertical transverse section showing the needles in their topmost position and the conventional swinging guide bar assembly in its most advanced position in which the stitching guides are in the back of the needles, i. e., on the hook side of the latter. Both the needle bar and the guide bar assembly are oscillated by separate eccentrics, geared together in a 2 to 1 ratio by mechanism not shown and which in itself forms no part of my invention.

Figure 2 is a similar view showing the same mechanism one quarter of the knitting cycle later, at which stage the

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needle bar is half way down and the guide bar assembly is fully retracted and in front of the needles.

Figure 3 shows the same mechanism, one half of the cycle after the start shown in Figure 1, at which stage the needles are in their lowermost position, and the guide bar assembly in its most advanced position, in the back on the needles (as it was in Figure 1) for the second time during the formation of the same stitch.

Figure 4 shows the mechanism at the three quarter stage of the knitting cycle, when the needles are half way up and moving upwards, and the guide bar assembly is fully retracted for the second time during the same stitch.

Figure 5 is a rear view of the mechanism showing means for shogging the guides.

In these drawings 1 indicates fixed sinkers or combs provided with a transverse rod 2, or its equivalent, which serves to knock over the loops as they are formed. Adjacent the sinkers 1 is a needle bar 3 on which are mounted lead blocks 4 in which a row of latch needles 5 are cast, each provided with the usual hook 6 and latch 7. The needle bar 3 is reciprocated by means of an eccentric 8 fixed upon a shaft 9 and rotating within a strap 10, pivotally connected to the needle bar at 11. A guide bar assembly 12 is pivotally mounted at 13 above the needles 5. This guide bar assembly comprises two guide bars 14 and 15, each carrying lead blocks 16 and 17 respectively, in which rows of guides 18 and 19 respectively are cast. The guides 18 are the stitching guides and the guides 19 the inlay guides. Although only one row of inlay guides is illustrated, it is understood that additional rows might be employed or none at all. The guide bar assembly 12 is oscillated by means of an eccentric 20 mounted on a shaft 21 and provided with the usual strap 22 pivotally connected at 23 to the guide bar assembly.

Each stitching guide 18 is provided with the usual eye 24 through which a stitching end 25 passes, and each inlay 19 is provided with an eye 26 through which an inlay end 27 passes. The stitching ends and the inlay ends, after passing through their respective guiding eyes, are led to the upper edge of the fabric 28.

The shogging mechanism is conventional, and is in no way different from the several identical mechanisms disclosed in the prior art, as, for instance, in the U. S. Patent No. 246,248 to Upton. It is shown schematically on Fig. 5 in which 31 is the drum carrying a chain 32 composed of links 33, one of which is always in contact with the roller 34 mounted on the rod 35 adapted to slide in a sliding bearing 36 and carrying a flat plate 37. The plate 37 is in sliding frictional contact with an adjustable finger 38, said contact being maintained by springs 39 and 40. The finger 38 is mounted on the guide bar 15 which is capable of sliding longitudinally in bearings 41, 41 mounted on brackets 42, 42, which are fixed on an oscillating bar 13, which is rocked by eccentrics 20 shown in Figures 1 to 4.

As usual, the height of the chain links 33 varies in accordance with a predetermined pattern, in multiples of the spacing between the needles 5. As roller 34 rolls from one link 33 to another, the rod 35 and the guide bar 15 shog a certain number of needle spacings, causing the guides 19 to lay their ends longitudinally, as called for by the pattern.

The machine just described operates as follows: Both the needle bar 3 and the guide bar assembly 12 oscillate in simple harmonic motion, being actuated by eccentrics 8 and 20 respectively which are geared together in a 2:1 ratio, so that the guide bar assembly eccentric 20 rotates twice as fast as the needle bar eccentric 8. When the needle bar 3 and the guide bar assembly 12 are in the position shown in Figure 1, that is, when the needle bar is in its topmost position and the guide bar assembly is in its most advanced position in the back of the needles, the stitching guides shog, laying their ends 25 below the needle hooks 6, whereupon the guide bar assembly 12

swings to the right, the tips of each thread guide passing between two adjacent needles as the latter begin their descent. One quarter of a knitting cycle later—the stage shown in Figure 2—the needle bar eccentric 8 will have turned through 90°, carrying the needle bar half way down; at the same time, the guide bar assembly eccentric 20 being rotated twice as fast, will have turned through 180° bringing the guide bar assembly all the way towards the front of the needles. By the end of the second quarter of the cycle—which stage is depicted in Figure 3—the needle bar eccentric 8 will have turned 180°, pulling the needles 5 into their lowermost position, while the guide bar assembly 12, its eccentric 20 having traveled 360°, will have again swung to the back of the needles, for the second time during the formation of the same stitch. By the end of the third quarter of the knitting cycle—as shown in Figure 4—the needle bar eccentric 8 will have traveled 270°, the needles 5 being half way on the way up; the guide bar assembly eccentric 20 having traveled 540°, the guide bar assembly is once again in front of the needles. Finally, by the end of the fourth quarter of the cycle the parts will have returned to the position shown in Figure 1, the shogged inlays having been passed between the appropriate needles. The needle bar eccentric 8 will have made one complete revolution and the guide bar assembly eccentric cam 20 two complete revolutions.

As shown in the drawings, the needle bar eccentric 8 and the guide bar eccentric 20 are set so that when the needles are in their uppermost position, as in Figure 1, the guide bar assembly is in its extreme advanced position, and the reversal of both needles and guides begins simultaneously. In practice there is a certain advantage in having the reversal of the guide bar assembly begin a little ahead of the reversal of the needle bar assembly which result can be obtained by slightly advancing the setting of the guide bar eccentric 20 with reference to the needle bar eccentric 8.

It is apparent from the foregoing that the guide bar assembly (which may include inlay guide bars or may be limited to the stitching guide bar or bars only) oscillates twice during each stitch or reciprocation of the needle bar, the stitching guides casting their ends under the needle hooks on one swing and doing no useful work on the other swing. At their relatively high speed, the inlay and stitching guides have no difficulty in passing back and forth through the row of needles while the latter are near their topmost position even though the needles are continuously in motion, and thus the ends are always under control. It follows, however, that the guide bar assembly is free wheeling through one complete oscillation. The purpose of the extra and, seemingly, superfluous oscillation of the guide bar assembly is two-fold: it makes it possible for the stitching guides to go much faster around the needles, without requiring a greatly increased swing and without sacrificing the advantages of simple harmonic motion for both the stitching guides and the needles; it also greatly increases the portion of the knitting cycle available for the shogging of inlays which can now shog at any time except when they are either between or directly in the back of the needle hooks: an increase from the conventional 35% of the cycle to about 75%, or better than double, permitting slower and longer shogs, and thus approximating the advantages described and claimed in my co-pending application, Serial No. 285,868, filed May 3, 1952, now Patent No. 2,699,658, January 18, 1955. In other words, the novel feature of my invention lies in the fact that, instead of being able to shog only when they are in front of the needles, the inlays, in my machine, can shog at any time except when they are either between or in the back of the needle hooks—that is, except when they overlap the needles in their uppermost position. Thus, for instance, the inlay shog can take place at any stage of the knitting cycle shown in Figures 2, 3 and 4, but not at the stage shown in Figure 1.

While the above drawings and description illustrate my invention as it is applied to a conventional warp knitting machine of the Raschel type, I want to make it quite clear that the basic principle of it may be applied with full force and effect to all other warp knitting machines, such as, for instance, tricot and the modified Raschel described in my above-co-pending application.

I claim:

1. A warp knitting machine comprising a reciprocable needle bar, a row of hooked needles carried by the bar, a reciprocable guide bar mounted adjacent the needles, end guides carried by the guide bar, means for reciprocating the needle bar in simple harmonic motion, and means for reciprocating the guide bar in simple harmonic motion to pass the end guides through the row of needles, the rate of reciprocation of the guide bar being a multiple of the rate of reciprocation of the needle bar.

2. A warp knitting machine comprising a reciprocable needle bar, a row of hooked needles carried by the bar, a reciprocable guide bar mounted adjacent the needles, stitching guides carried by the guide bar, means for reciprocating the needle bar in simple harmonic motion, means for reciprocating the guide bar in simple harmonic motion to pass the stitching guides through the row of needles, and means for shogging the stitching guides behind the needles, the rate of reciprocation of the guide bar being a multiple of the rate of reciprocation of the needle bar.

3. A warp knitting machine comprising a reciprocable needle bar, a row of hooked needles carried by the bar, a reciprocable guide bar assembly mounted adjacent the needles, a row of stitching guides and a parallel row of inlay guides carried by the guide bar assembly, means for reciprocating the needle bar in simple harmonic motion, means for reciprocating the guide bar assembly in simple harmonic motion to pass the stitching and inlay guides through the row of needles, means for shogging the stitching guides behind the needles and means for shogging the inlay guides in front of the needles, the rate of reciprocation of the guide bar assembly being a multiple of the rate of reciprocation of the needle bar.

4. A warp knitting machine comprising a reciprocable needle bar, a row of hooked needles carried by the bar, a reciprocable guide bar mounted adjacent the needles, end guides carried by the guide bar, an eccentric for reciprocating the needle bar in simple harmonic motion and an eccentric for reciprocating the guide bar in simple harmonic motion to pass the end guides through the row of needles, the speed of rotation of the guide bar eccentric being a multiple of the speed of rotation of the needle bar eccentric.

5. A warp knitting machine comprising a reciprocable needle bar, a row of hooked needles carried by the bar, an oscillatable guide bar mounted adjacent the needles, stitching guides carried by the guide bar, an eccentric for reciprocating the needle bar in simple harmonic motion, an eccentric for oscillating the guide bar in simple harmonic motion to pass the stitching guides through the row of needles, and means for shogging the stitching guides behind the needles, the speed of rotation of the guide bar eccentric being a multiple of the speed of rotation of the needle bar eccentric.

6. A warp knitting machine comprising a vertically reciprocable needle bar, a row of hooked needles carried by the bar, an oscillatable guide bar assembly mounted above the needles, a row of stitching guides and a parallel row of inlay guides carried by the guide bar assembly, an eccentric for reciprocating the needle bar in simple harmonic motion, an eccentric for oscillating the guide bar assembly in simple harmonic motion to pass the stitching and inlay guides through the row of needles, means for shogging the stitching guides behind the needles and means for shogging the inlay guides in front of the needles, the speed of rotation of the guide bar assembly eccentric being twice the speed of rotation of the needle bar eccentric.

7. A warp knitting machine comprising a reciprocable needle bar, a row of hooked needles carried by the bar, a reciprocable guide bar mounted adjacent the needles, end guides carried by the guide bar, means for reciprocating the needle bar in simple harmonic motion, and means for reciprocating the guide bar in simple harmonic motion to pass the end guides through the row of needles, the guide bar reaching its extreme advanced position in back of the needles slightly before the latter have reached their uppermost position, the rate of reciprocation of the guide bar being a multiple of the rate of reciprocation of the needle bar.

8. A warp knitting machine comprising a reciprocable needle bar, a row of hooked needles carried by the bar, a reciprocable guide bar mounted adjacent the needles, end guides carried by the guide bar, an eccentric for reciprocating the needle bar in simple harmonic motion and an eccentric for reciprocating the guide bar in simple harmonic motion to pass the end guides through the row of needles, the guide bar eccentric being set slightly in advance of the setting of the needle bar eccentric, the speed of rotation of the guide bar eccentric being a multiple of the speed of rotation of the needle bar eccentric.

9. The method of warp-knitting which comprises reciprocating a row of hooked needles in simple harmonic motion and reciprocating end-carrying guides through the plane of the needles in simple harmonic motion to pass the ends between adjacent needles and at a rate of reciprocation which is a multiple of the rate of reciprocation of the needles.

10. The method of warp-knitting which comprises reciprocating a row of hooked needles in simple harmonic motion and reciprocating end-carrying stitching guides through the plane of the needles in simple harmonic motion to pass the ends between adjacent needles at a rate of reciprocation which is a multiple of the rate of reciprocation of the needles, and shogging the stitching guides behind the needles.

11. The method of warp-knitting which comprises reciprocating a row of hooked needles in simple harmonic motion and reciprocating end-carrying stitching and inlay guides through the plane of the needles in simple harmonic motion to pass the ends between adjacent needles at a rate of reciprocation which is a multiple of the rate of reciprocation of the needles and shogging the stitching guides behind the needles and the inlay guides in front of the needles.

12. The method of warp-knitting which comprises reciprocating a row of hooked needles in simple harmonic motion and reciprocating end-carrying guides through the plane of the needles in simple harmonic motion to pass the ends between adjacent needles at a rate of reciprocation which is a multiple of the rate of reciprocation of the needles, the end-carrying guides reaching their most advanced position in back of the needles slightly before the needles have reached their uppermost position.

13. The method of warp-knitting which comprises reciprocating a row of hooked needles in simple harmonic motion and reciprocating end-carrying stitching and inlay guides through the plane of the needles in simple harmonic motion to pass the ends between adjacent needles at a rate of reciprocation which is a multiple of the rate of reciprocation of the needles, the end-carrying guides reaching their most advanced position in back of the needles slightly before the latter have reached their uppermost position, and shogging the stitching guides behind the needles and the inlay guides in front of the needles.

14. A warp knitting machine comprising a reciprocable needle bar, a row of hooked needles carried by the bar, a reciprocable guide bar assembly mounted adjacent the needles, a row of stitching guides and a parallel row of inlay guides carried by the guide bar assembly, means for reciprocating the needle bar in simple harmonic motion, means for reciprocating the guide bar assembly in simple harmonic motion to pass the stitching and inlay guides through the row of needles, means for shogging the stitching guides behind the needles and means for shogging the inlay guides when the inlay ends are neither between nor directly in back of the needle hooks, the rate of reciprocation of the guide bar assembly being a multiple of the rate of reciprocation of the needle bar.

15. A warp knitting machine comprising a vertically reciprocable needle bar, a row of hooked needles carried by the bar, an oscillatable guide bar assembly mounted above the needles, a row of stitching guides and a parallel row of inlay guides carried by the guide bar assembly, an eccentric for reciprocating the needle bar in simple harmonic motion, an eccentric for oscillating the guide bar assembly in simple harmonic motion to pass the stitching and inlay guides through the row of needles, means for shogging the stitching guides behind the needles and means for shogging the inlay guides when the inlay ends are neither between nor directly in back of the needle hooks, the speed of rotation of the guide bar assembly eccentric being twice the speed of rotation of the needle bar eccentric.

16. The method of warp-knitting which comprises reciprocating a row of hooked needles in simple harmonic motion and reciprocating end-carrying stitching and inlay guides through the plane of the needles in simple harmonic motion to pass the ends between adjacent needles at a rate of reciprocation which is a multiple of the rate of reciprocation of the needles, shogging the stitching guides behind the needles and shogging the inlay guides when the inlay ends are neither between nor directly in back of the needle hooks.

17. The method of warp-knitting which comprises reciprocating a row of hooked needles in simple harmonic motion and reciprocating end-carrying stitching and inlay guides through the plane of the needles in simple harmonic motion to pass the ends between adjacent needles at a rate of reciprocation which is a multiple of the rate of reciprocation of the needles, the end-carrying guides reaching their most advanced position in back of the needles slightly before the latter have reached their uppermost position, shogging the stitching guides behind the needles and shogging the inlay guides when the inlay ends are neither between nor directly in back of the needle hooks.

References Cited in the file of this patent

UNITED STATES PATENTS

246,248	Upton	Aug. 23, 1881
1,100,750	Lindley	June 23, 1914
2,012,355	Schonfeld	Aug. 27, 1935
2,292,287	Peel et al.	Aug. 4, 1942

FOREIGN PATENTS

3,032	Great Britain	of 1878
5,235	Great Britain	of 1884
302,185	Great Britain	Feb. 6, 1930
802,809	France	June 22, 1936