Jan. 11, 1944. E. COTTERILL 2,339,153

WARP KNITTING MACHINE

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FIG. 1.

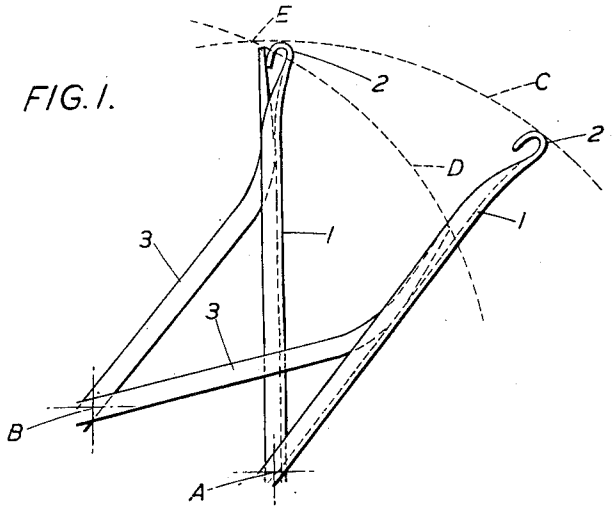
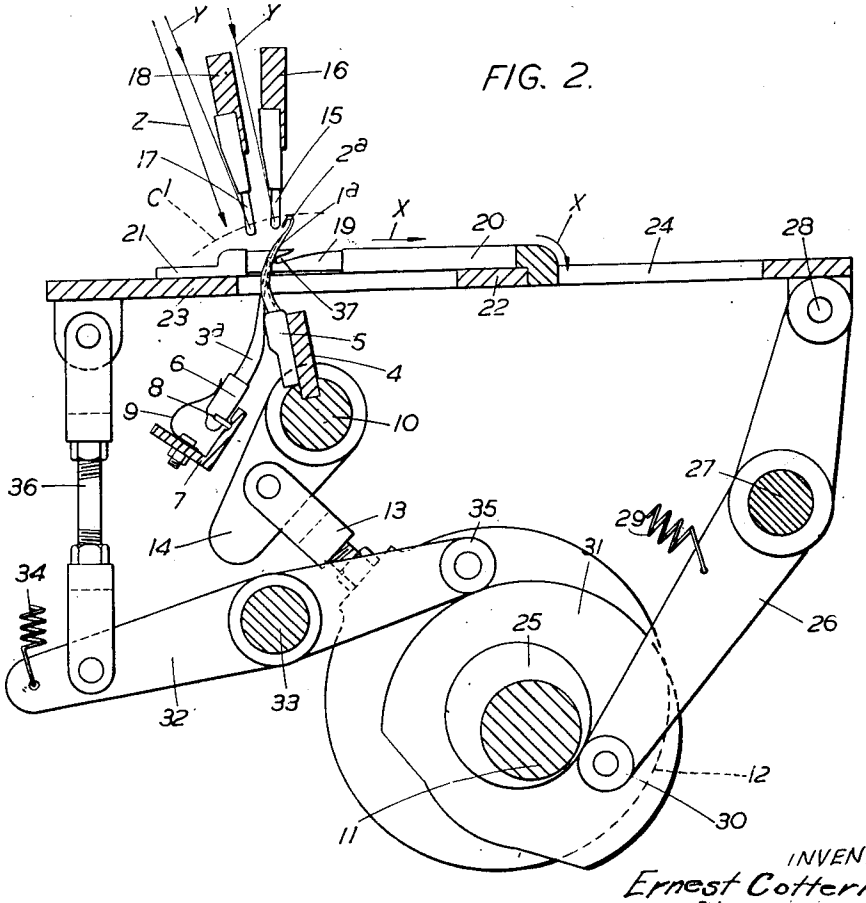



FIG. 2.

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WARP KNITTING MACHINE

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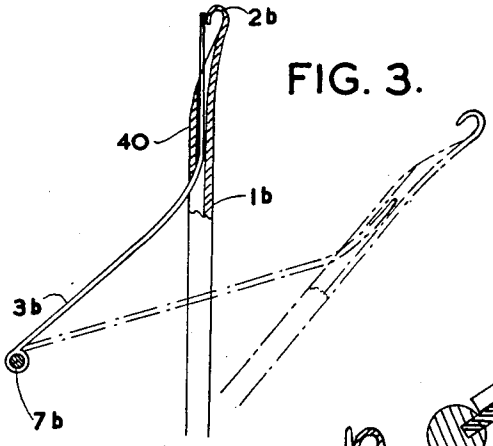


FIG. 3.

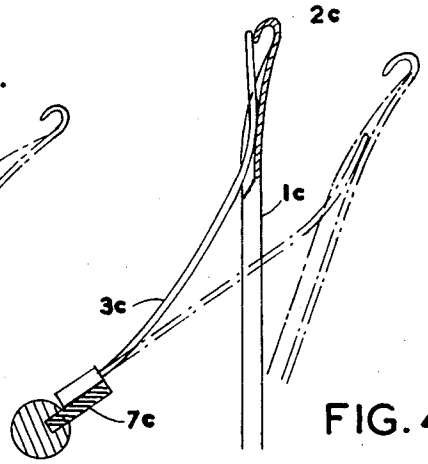


FIG. 4.

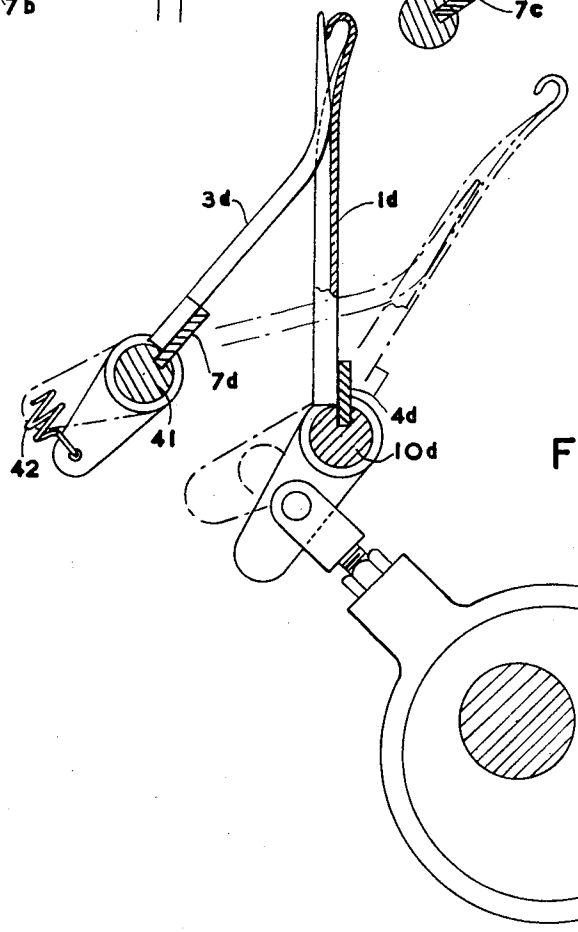


FIG. 5.

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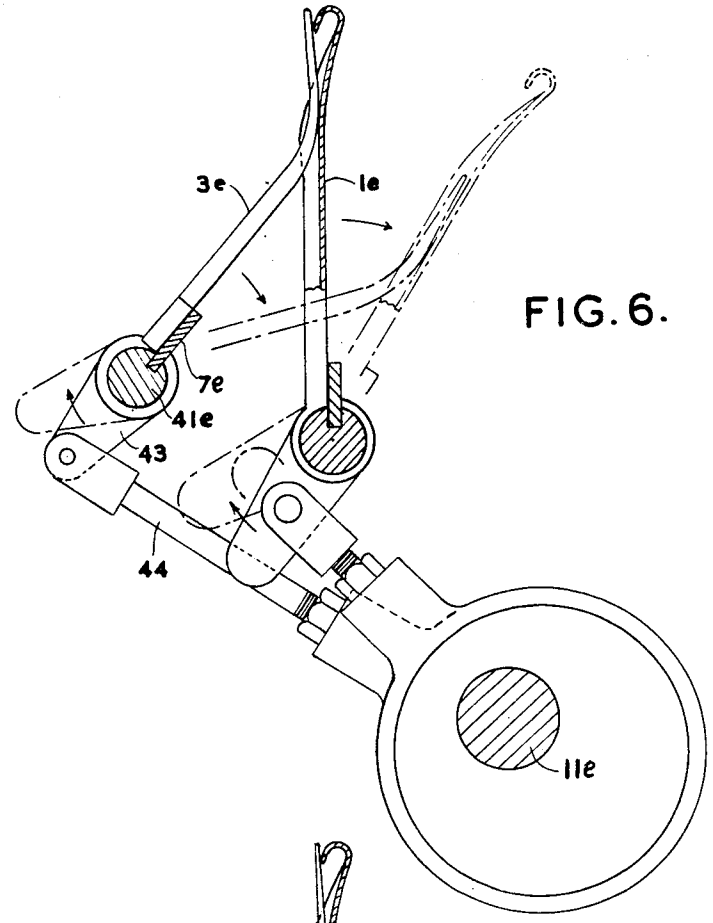


FIG. 6.

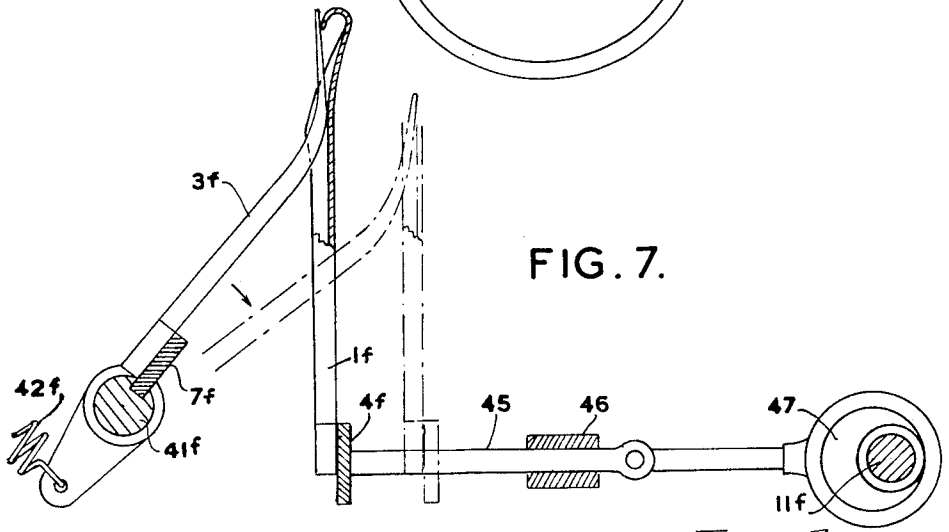


FIG. 7.

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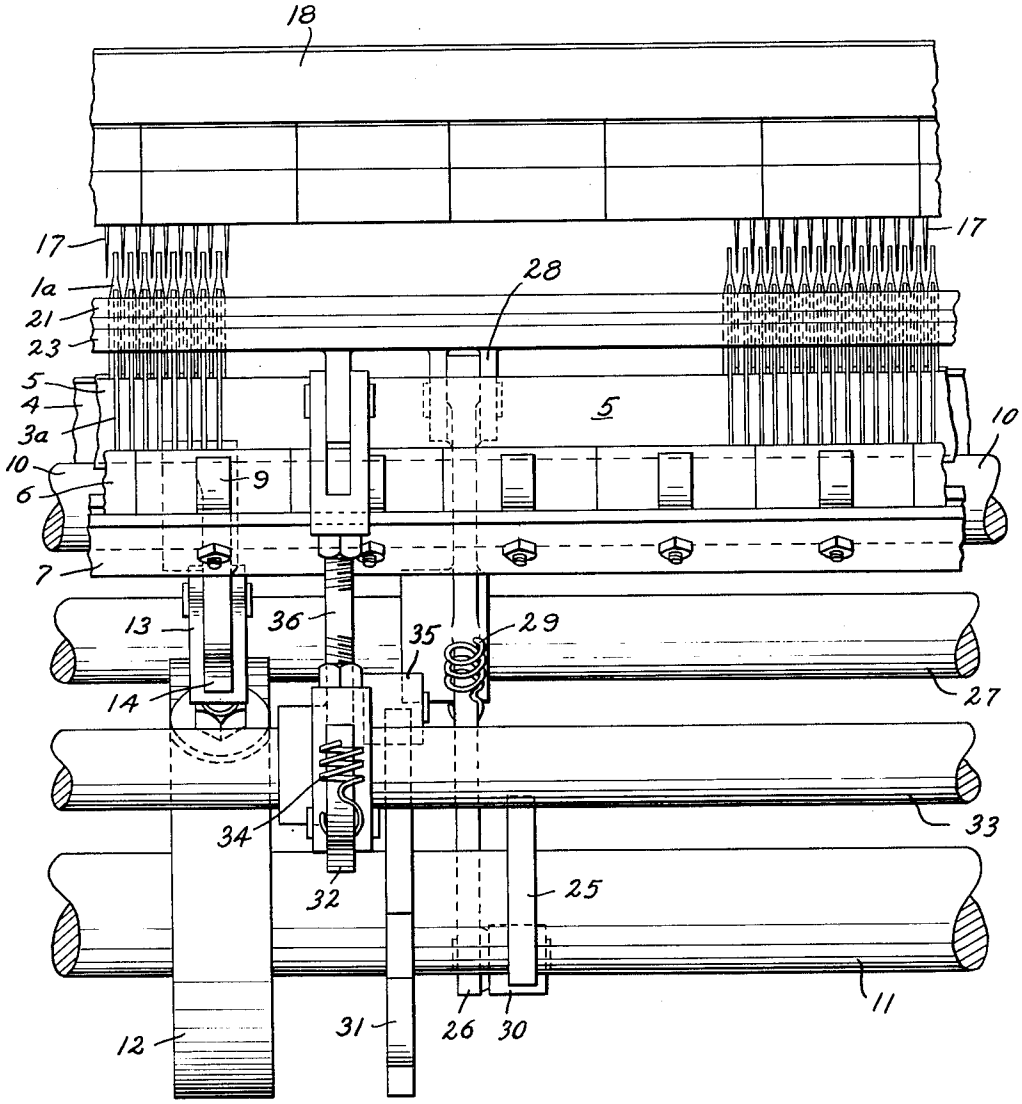
FIG. 8

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Patented Jan. 11, 1944 2,339,153

# UNITED STATES PATENT OFFICE

2,339,153

## WARP KNITTING MACHINE

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Application June 24, 1942, Serial No. 448,288
In Great Britain July 17, 1941

6 Claims. (Cl. 66—86)

There have been various proposals to provide knitting machines with hook needles that co-operate with independent tongues which slide in grooves or bores in the shanks of the needles. In such arrangements each needle is moved to-and-fro along a straight or arcuate line substantially coincident with the axis of its shank, and the co-operating tongue is similarly moved in timed relationship with the needle between a position in which the tip of the tongue is concealed in the needle shank and a position in which the tip of the tongue overlaps the needle hook. The shank has to be formed with a short tapered portion the apex of which joins the base of the hook so that, when the tip of the tongue is concealed in the shank, a loop of yarn from within the hook can pass to a point enabling the tongue to pass through the loop. Then, the loop is cast off over the tip of the tongue and over the hook while the tongue overlaps the hook.

An aim of the present invention is to simplify the action of knitting machines, particularly of warp knitting machines which may be capable of high speed operation and readily adapted for the insertion of weft into the knitted fabric. This aim is achieved, according to the invention, by providing a warp knitting machine with hook needles along which the tips of tongues move while the needles and tongues are moved to-and-fro transversely to the needle shanks and in the planes of the needle hooks. Conveniently this movement may be imparted by causing the group of needles and the group of tongues respectively to swing about separate axes remote from the needle hooks and from the tips of the tongues. Then, while part of each tongue remains continuously in engagement with the associated needle, the transverse movement of the needle and tongue as a result of the swinging motion causes the tip of the tongue to move towards and away from a position in which it covers the needle hook.

The transverse swinging motion of the needles in the planes of their hooks enables the machine to be provided with a simplified warp guide assembly in which the warp guides are only moved parallel to the row of needles in accordance with the pattern of the knitted fabric being made, the usual transverse swinging movement of the warp guides being unnecessary.

In order that the invention may be clearly understood and readily carried into effect, mechanism in accordance therewith will now be described, by way of example, with reference to the accompanying drawings, in which

Figure 1 is an explanatory diagram,

Figure 2 is a vertical section through part of a warp knitting machine; Figures 3 to 7 are sectional diagrammatic elevations, respectively, of modifications of the needle and tongue assembly appearing in Fig. 2; and Fig. 8 is a partial view in elevation of the warp knitting machine shown in Fig. 2.

Figure 1 shows diagrammatically the manner of operation of a needle and tongue assembly used in the machine of Figure 2. Referring to Figure 1, a needle 1, which is shown in two positions, is formed at one end with a hook 2 and has a grooved shank in which lies part of a tongue 3, shown in two positions corresponding to the two positions of the needle. Previously, the needle and tongue in such an assembly have been arranged to undergo relative to-and-fro movement along the axis of the needle shank. According to the present invention, however, the needle and tongue, instead of undergoing longitudinal movement, are arranged to swing to-and-fro respectively about axes A and B. Thus, the needle hook traverses an arc C and the tip of the tongue traverses an arc D. These two arcs intersect at a point E so that the tip of the tongue overlaps the needle hook at this point but is withdrawn into the groove in the needle shank when the needle and tongue have moved to a position such as the right-hand position in Figure 1. Accordingly, the movement of the tip of the tongue relatively to the needle necessary for knitting takes place solely as a result of the swinging movements about the axes A and B.

In the warp knitting machine of Figure 2, there is a row of needles 1*a* and a row of tongues 3*a* which extend respectively into the grooves in the needles 1*a*. As usual in a warp knitting machine, the needles are carried in a long row, parallel to each other, by a needle bar 4, the tail ends of the needles being moulded into blocks 5 of lead or synthetic resin secured side by side along the length of the needle bar 4. Figure 2 is a vertical section in a plane at right angles to the length of the machine so that only one of the needles appears, and this in side elevation, while the needle bar appears in cross-section. This, of course, applies also to the other knitting elements, which are described below, and to the bars carrying them.

The tail ends of the tongues 3*a* are moulded into blocks 6 of lead or synthetic resin pivotally mounted side by side along the length of an angle-section tongue bar 7 rigidly mounted in the machine. The pivotal connection between the

blocks 6 and the bar 7 is provided by blades 8, secured in the blocks 6 and projecting into a longitudinal groove in the bar 7 to form a knife-edge pivot. Leaf springs 9 distributed along the tongue bar 7 bear on the blocks 6 to maintain the tongues in their respective needle grooves.

The needle bar 4 is fixed to a rock shaft 10 and is rocked about the axis of that shaft by eccentrics distributed along the length of a driving shaft 11 which is rotated uniformly during the operation of the machine. The strap 12 of one such eccentric appears in Figure 2 and each such strap carries a rod 13 pivoted to an associated arm 14 fixed to the rock shaft 10. The needles are swung to-and-fro through an angle of the order of 20° about the axis of the shaft 10 while the tongues 3a undergo corresponding movements, being moved in a counter-clockwise direction (as viewed in Figure 2) by the needles themselves and in the opposite direction by the leaf springs 9. At all times the tongues engage the bases of the grooves in the needle shanks.

In warp knitting machines as normally constructed hitherto, in which the needles reciprocate along the axes of their shanks, the warp guides necessary to lay the threads on the needles are swung to-and-fro transversely across the plane in which the row of needles lies. However, in the example shown in Figure 2, the movement of the needles themselves is such that this transverse movement of the warp guides is unnecessary and there are two rows 15 and 17 of warp guides carried respectively by guide bars 16 and 18 which do not move transversely. Nevertheless, as the needles are rocked, their hooks 2a follow an arc C' so that the required relative movement between the needles and warp guides takes place. In this fashion the threads are received by the needles as each needle passes between a pair of warp guides. It will, however, be appreciated that, although the guide bars 16 and 18 do not undergo any transverse movement, it is still necessary to move them longitudinally according to some pattern in order to impart the so-called "shogging" movements to the warp guides.

So that the required amount of movement of the loops of yarn along the needles may take place, it is necessary to arrange sinkers 19 to ensure firstly that the loops travel to positions on the needles 1a in which the tongues 3a can pass through them, and secondly that the loops are knocked over the hooks 2a in the casting-off operation. To enable the sinkers to perform these functions, they are arranged to undergo both horizontal and vertical movements. The sinkers are, therefore, secured at their opposite ends in blocks 20 and 21, mounted respectively on longitudinal bars 22 and 23 in a frame 24 which has substantially horizontal movements imparted to it at one side, and substantially vertical movements imparted to it at the other side. It will be seen that the needles 1a and tongues 3a project upwards so that each needle and its associated tongue passes between a pair of sinkers 19. The horizontal transverse movements are imparted to the frame 24 by cams 25 distributed along the driving shaft 11 and acting on rockers 26 pivoted about an axis 27, the rockers respectively being pivoted to the frame 24 by points distributed along an axis 28. A spring 29 maintains a roller 30 on each rocker 26 in engagement with the associated cam 25. The vertical movement is imparted to the other side of the frame 24 by cams 31 distributed along and fixed to the driving shaft 11. Each such cam acts on a follower 32 mounted to swing about an axis 33, a spring 34 maintaining a roller 35 on the follower 32 in engagement with the associated cam 31. Each follower 32 is connected to the frame 24 by a link 36. Each sinker 19 is formed with a throat 37 shaped to control the loops of yarn in the desired fashion as the composite motion is imparted to the sinkers. The cloth is withdrawn in the direction of the arrows X and passes through the frame 24, while the warp threads pass to the warp guides 15 and 17 in the direction of the arrows Y. When weft is to be incorporated strands of weft are fed towards the sinkers 19 in a plane, containing the arrows Z, parallel to the rows of warp guides. Then, each weft thread is deposited into the fabric at a point just to the right of the sinker throats 37, when the sinkers have been raised and moved to the left substantially to the end of their stroke remote from that in which they appear in Figure 2, and when the needle hooks have been swung downwards beneath the sinker throats.

Many modifications of the machine appearing in Figure 2 are possible. For instance, the needles and tongues may be constructed as shown in Figure 3 where the needle 1b has a grooved shank which, towards its forward or upper end, becomes tubular in cross-section, and each tongue 3b consists of a resilient wire pivoted on a fixed rod 7b. The tongue projects through the tubular portion 40 of the shank, and when the needle is in the position shown in full lines, the tip of the tongue overlaps the needle hook 2b. When, however, the needle is swung to a position such as that shown in chain lines in Figure 3, the tip of the tongue is withdrawn into the shank.

Figure 4 shows a needle 1c which is substantially the same as the needle 1 appearing in Figure 1. The associated tongue, however, consists of a resilient wire 3c, the lower end of which is fixed to a tongue bar 7c that remains stationary during the operation of the machine. The tongue 3c, however, is so positioned that it always bears on the needle 1c within the groove in the shank thereof. Thus, when the needle is in the position shown in full lines in Figure 4, the tongue is flexed so that its tip overlaps the needle hook 2c, but when the needle is swung back to a position such as that shown in chain lines, the tip of the tongue recedes into the groove in the needle shank.

In the arrangement shown in Figure 5, a row of needles 1d is carried by a needle bar 4d mounted on a rock shaft 10d arranged to be rocked to-and-fro in the same manner as the rock shaft 10 in Figure 2. The associated tongues 3d are fixed to a tongue bar 7d mounted on a rock shaft 41 which is biased about its axis in a clockwise direction, as viewed in Figure 5, by one or more springs 42. Thus, the tongues 3d are maintained in engagement with the needles 1d in all positions of the latter in their to-and-fro motion about the axis of the rock shaft 10d.

The arrangement shown in Figure 6 differs from that shown in Figure 5 in that the tongues 3e, instead of being moved directly by the needles 1e, are positively driven by eccentrics mounted on a driving shaft 11e which also operates the needles 1e. The tongues 3e are carried by a tongue bar 7e mounted on a rock shaft 41e. Distributed along this rock shaft are arms 43 connected by eccentric rods 44 to the straps of eccentrics distributed along the shaft 11e.

Figure 7 shows that it is not essential for the needles to undergo rocking motion in the planes

of their hooks, but they may undergo straight translational motion to-and-fro transversely to their shanks and in the planes of their hooks. Thus, the needles 1*f* are carried by a needle bar 4*f* fixed to rods 45 distributed along the length of the needle bar 4*f*. These rods 45 can slide in horizontal guides 46 and are reciprocable longitudinally by eccentrics 47 on a driving shaft 11*f*. The tongues 3*f* associated with the needles 1*f* are carried by a tongue bar 7*f* fixed to a rock shaft 41*f* loaded by one or more springs 42*f*. Accordingly, as the needles are moved to-and-fro between positions such as those shown by full lines and chain lines in Figure 7, the tongues 3*f* are correspondingly rocked about the axis of the rock shaft 41*f*.

What I claim is:

1. In a warp knitting machine, a plurality of needles, each formed with a hollow shank and with a hook at one end of said shank, tongues allocated respectively to said needles and each arranged with one end in operative association with the corresponding needle and with the other end remote from the needle, and means for moving said needles and said tongues to-and-fro in the planes of the needle hooks and in paths intersecting the needle shanks at a substantial angle, whereby the tips of said tongues are caused alternately to overlap said needle hooks and to recede into said hollow shanks.

2. In a warp knitting machine, a plurality of needles, each formed with a hollow shank and with a hook at one end of said shank, said needles being mounted to swing to-and-fro about an axis in the proximity of their shanks and remote from their hooks, a plurality of tongues mounted to swing about an axis remote from, but parallel to, said first mentioned axis, means for oscillating said needles about said first mentioned axis, and means maintaining the tips of said tongues in operative relationship with said needles during said oscillating motion, whereby the tips of said tongues alternately overlap said needle hooks and are withdrawn into the hollow needle shanks.

3. In a warp knitting machine, a group of needles mounted parallel to each other in one plane, a group of tongues mounted parallel to each other in a second plane intersecting said first mentioned plane, and means for moving each of said groups to-and-fro transversely to its plane while the line of intersection between said planes shifts between a position in which the tips of said tongues are concealed in said needle shanks and a position in which the tips of said tongues overlap said needle hooks, one of said groups being pivoted to swing about an axis remote from, and parallel to, the plane, containing the other group.

4. In a warp knitting machine, a plurality of warp guides mounted to remain constantly in a stationary plane, a plurality of hook needles, each formed with a hollow shank and with a hook at one end of said shank, mounted in another plane to move to-and-fro across the plane of said warp guides to gather threads from same, and a plurality of tongues mounted in a third plane to move to-and-fro in sympathy with the motion of said needles between a position in which the tips of said tongues overlap the needle hooks and a position in which said tips of said tongues are concealed in the hollow needle shanks.

5. In a warp knitting machine, a plurality of hook needles, each formed with a hollow shank and with a hook at one end of said shank, said needles being mounted to swing to-and-fro about an axis in the proximity of said shanks and remote from said hooks, a plurality of tongues anchored along a second axis parallel to, but remote from, the first mentioned axis, and each allocated to one of said needles, means for swinging said needles about said first mentioned axis while said tongues cooperate with said needles in moving to-and-fro between a position in which their tips overlap the needle hooks and a position in which their tips are withdrawn into the needle shanks, and a plurality of sinkers adapted to move loops of yarn longitudinally along said needles to cast said loops off said needles.

6. In a warp knitting machine, a plurality of needles, each formed with a hollow shank and with a hook at one end of the shank, means for moving said needles to-and-fro transversely to their shanks and in the planes of their hooks, a plurality of sinkers adapted to move loops of yarn longitudinally on said shanks, means for imparting to said sinkers two components of motion respectively substantially longitudinally and transversely with respect to said needles, a plurality of tongues also mounted to move to-and-fro transversely to said needle shanks and in the planes of said needle hooks between a position in which the tips of said tongues overlap said needle hooks and a position in which the tips of said tongues are concealed in said needle shanks, and a plurality of warp guides mounted to remain in a stationary plane while said needles receive yarn therefrom in the to-and-fro motion of said needles.

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