FLATBED KNITTING MACHINE

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This invention relates to a flat bed knitting machine. There is a known knitting machine including coordinated needle beds having double-hack knitting needles reciprocable therein and a carriage movably mounted on the two needle beds to reciprocate the double hook knitting needles. However, this knitting machine has had a deficiency in that an increasing or decreasing of stitches indispensable to knitting operations, cannot be carried out conveniently. In a plain knitting, only one hooked end of double-hooked knitting needles is used, with the result that a single-hooked knitting machine, having a more simple structure, is preferable to the double-hooked knitter. The present invention is designed to remove this deficiency.

Hence, an object of the present invention is to provide a double-hooked needle knitting machine wherein a double-hooked knitting needle is reciprocated in a knitting operation by operating laterally a single carriage mounted movably on the main needle bed.

Another object of the present invention is to provide a double-hooked needle knitting machine wherein the main needle bed is provided with needle tricks on upper guide plate, jacks and so forth, whereas a supplementary needle bed coordinated to said main needle bed comes in use only when double-sided knitting, for instance rib-knitting, is performed. This supplementary needle bed may be tipped downward during one-sided knitting without causing the double-hooked knitting needle to be reversed or dialogued.

With these objects in view, description of the present invention is now made with reference to the attached drawings illustrating an embodiment of the present invention, in which:

FIG. 1 is a side elevational view of the needle beds and associated parts;
FIG. 2 is a plan view of the needle beds;
FIG. 3 is an enlarged sectional view taken on the line III—III of FIG. 2;
FIG. 4 is a bottom plan view of the carriage;
FIG. 5 is a perspective view of a double-hooked knitting needle and a jack as interengaged with each other;
FIGS. 6 to 12 are side elevation views illustrating a stitch formation;
FIG. 13 is a plan view of a part of FIG. 10 shown in enlargement; and
FIG. 14 is a plan view of a part of FIG. 11, shown in enlargement.

Referring first to FIGS. 1, 2 and 3, a main needle bed 1 has operatively associated therewith a supplementary or auxiliary needle bed 2 which is pivotal between a position in which it is coplanar with main needle bed 1 and a position in which it extends downwardly substantially normal to main needle bed 1. Each of the two needle beds is provided with a series of longitudinally extending parallel needle tricks 3, receiving double hook needles 9 each having a latch-type hook a at its right end, as viewed in FIG. 1, and a latch-type hook b at its left end as viewed in FIG. 1. Trick walls 4 extend upwardly of needle bed 1 between the slots 3, and their upper surfaces are substantially coplanar to serve as a support for a cover or upper guide plate 5 which is engageable with the upper surfaces of the hooks of the needles 9 so as to retain these needles in position against any force component tending to lift them out of their respective needle tricks 3. Trick walls 4 serve as guides for jacks 6 each having a jack butt 7 at its rear or righthand end which extends upwardly through slots 8 in guide plate 5 to project above the guide plate.

A carriage 11 is mounted for reciprocation laterally of main needle bed 1, and is guided by transversely extending rails 13 on the upper surface of guide plate 5. In their coplanar position, needle beds 1 and 2 define a slot between their facing edges, and each needle bed has, along the opposite sides of this slot, sinkers 12 of a width not to hinder the hook end of a jack from being opened or closed. It should be noted that the height or thickness or stems 10 of needles 9 is equal to the depth of the needle slots 3. The hooks a and b have a length sufficient that their associated latches will not be lifted as these hooks are engaged with the operating ends of jacks 6.

In FIG. 4, elements 14, 14', 15, 16 are jack operating cams for reciprocating the knitting needles, and are so adapted as to come into operation when knitting is done solely with the left hooked end a of the double-hooked knitting needle 9, and elements 17, 17', 18, 19, 19' are jack operating cams which come into operation when knitting is done with the right hooked end a of the needle 9, interengaged with a jack 6 as shown in FIG. 5.
Cams 14, 14', 17 and 17' are pivotally mounted at fulcrums 23, and have free ends extending towards the outer sides of the carriage 11. These cams serve as main operatingcams urged towards cam 16 and cams 20, 20' respectively, under the bias of spring means 32 provided to each of cams 14, 14', 17, 17'. Each of said spring means 32 is supported between two pins; one of which is secured one end thereof to the main body of the carriage, and the other of which is secured one end thereof to a corresponding cam and projects other end thereof outwardly of the body of the carriage in the form of an engraving on the outer plate of the carriage so that the pin may be reciprocated therealong by action of the spring 32. Cams 15 and 18 are lifting cams each having a trapezoidal shape and arranged centrally between the main operatingcams 14, 14' and 17, 17', respectively. Numerals 16 is a guide plate or cam, and numerals 19, 19' and 20, 20' are operatingcams for removing stitches and are disposed intermediate main cams 17, 17' and lifting cam 18 and operable to remove formed stitches as the latter passed between interengaged jaws 6 and needles 9. Cam 21 is a transfer cam which is movable into and out of an operative position and is used only in knitting other than simple purf stitching or knit stitching, for example, in alternate formation of purf stitches and knit stitches every course; in shifting stitches from purf stitch to knit stitch vice versa; and in shifting from pattern knittings to plain knitings. Numerals 24, 25 and 26 in FIG. 4 illustrate respective loci or paths of movement of the butts 7 of needles 6 during a knitting operation effected by reciprocation of carriage 11 of the invented knitting machine.

As particularly illustrated in FIG. 5, each jack 6 includes a relatively elongated stem having a substantially rectangular cross section, the butt 7 projecting upwardly at the right hand end of this stem as illustrated in FIG. 5 and a leaf spring extending along one longitudinal edge of the stem and being secured to the stem somewhat forwardly or to the left of the butt 7. Said leaf spring has a bent portion 27 projecting outwardly beyond the concave left end edge of the stem of the jack 6 for engagement with the hook a of the needle 9. An end of the bent hooked portion 27 of the leaf spring comes into engagement with the hook a of the needle 9 during knitting operation. Said hooked end 27 may be deflected laterally with respect to the stem of the jack so as to allow the already formed stitches to slip therethrough.

In describing formation of a stitch with reference to FIGS. 6 to 14, which show a process of a stitch formation, FIG. 6 shows a position of a stitch which has been already and completely formed and preparation of succeeding formation of a new stitch. When knitting is made according to the locus 26 as shown in FIG. 4, the butt 7 is transferred to the outer side of the main cam 17, and the carriage 11 is then moved to the right. By such engagement of the jack butt 7 with the main cam 17, the needle 9 is pulled to the right by means of the leaf spring of the jack 6, meanwhile the already formed stitch is left unmoved at its normal position against jack of the needle 9. The rightward movement of the needle 9 caused by the cam 17 and the stitch remained unmoved against said movement and causes a latch 30 of the hook a of the needle 9, as shown in FIG. 7. That is, the formed stitch 28 is slid forcibly pushing the latch 30 to the left side in FIG. 7. The rightward movement of the needle 9 is kept on until the already formed stitch 28 is completely released or removed away from the latch 30 of the needle hook 9. FIG. 8 shows that needle 9 in a short suspension after the already formed stitch 28 is removed from the latch 30. At the moment, the butt 7 of the jack 6 becomes engaged with the lifting cam 18, which in turn, causes the leftward movement of the needle 9. During the leftward movement of the needle 9, the latch 30 is pushed upwardly (in FIG. 9) by the already formed stitch positioned out of the latch 30, and at the same time a fresh yarn 29 is fed through the guide yarn into the hook a of the needle 9. Immediately after feeding of the fresh yarn 29 is finished, the latch 30 is completely closed to be restored to its original engagement, and the stitch 28 travels over the needle 9 until the stitch is pressed to one side of the hooked end of the leaf spring which is in engagement with the hook a. as shown in FIG. 13. The formed stitch 28 thus pressed to the side of the hooked end of the leaf spring deflects the hooked end thereof laterally against the retaining member which is fastened to the left end of the leaf spring at an angle taken into consideration in engagement of the hooked end with the hook a so as to permit said hooked end to be readily disengaged. The leftward movement of the needle 9 is further continued, and the stitch 28 becomes positioned between the outside of the hook a and the concave end edge of the jack 6 as shown in FIG. 11. It is noted that the height of the concave end is formed in relatively larger size with relation to that of the hook a, so that the stitch can never get over the height of the concave end of the jack 6, which is shown in FIG. 14. At this time, the leftward movement of the needle 9 comes to an end, and in turn, the jack 6 is slightly pulled rightwards by engagement of the butt 7 with the cam 20, thereby forming a gap between the concave end and the hook a. Into such gap the stitch 28 is dropped, while the newly fed and tucked yarn is held in the hook 9, whereby formation of a stitch is completed. FIG. 12 shows a completely formed stitch 28 and a newly fed yard held by the hook a.

And then, the butt 7 pushes open the cam 17' against the bias of its spring means and moves out of the carriage 11, when the newly formed stitch in the hook a of the knitting-needle is tucked up sufficiently. In this connection, the stitch formation at the hook b is exactly the same as in a knitting machine using single-hooked knitting needles and performed by the jack butts 7 moving along the locus 25.

When the carriage is operated according to the locus 24, the knitting needles are stationary. The locus 25 is for purf stitching, while the locus 26 is for knit stitching.

When, in purf knitting, all needles are brought into operation by operation of the jack butts along the locus 25, the knitting needles and prevented from disengagement by the upper guide plate 5 of the main needle bed, the hooked end of each jack 6 is maintained between thick walls 4 and supplementary needle bed 2 is maintained in the normal position confronting to the main needle bed 1. Thereby, the stitch is prevented from falling out of the needle bed along with the knitting-needle, and knitting is done smoothly in the same way as in the well-known plain knitting.

When knit stitches and purfl stitches are formed alternately at each course, as in garter knitting, transfer cams 21, 21' must be put into operative position. By operation of said transfer cams 21 and 21', either of butts 7 engaged with the main operating cams 14' and 17' can be directed to come into engagement with the lifting cam 18, and moves along the locus 26 through cams 19 and 20. Thus, the butt moves out of the carriage 11. In that event, it is done at the hooked end a at the right end of the needle 9. When the butts 7 are operating at the other side of the carriage 11, they come into engagement with the lifting cam 15 through the main operating cam 17 and the transfer cam 21, and are moved out of the carriage 11 through the main operating cam 14. In this event, it is done at the left hook b of the needle 9. By repetitions of these performances, garter knitting is completed.

As described above with reference to an embodiment of the present invention, various pattern knittings, including plain knitting, double-sided knitting and alternate knitting of knit-stitches and purfl-stitches at each row are possible by operating the knitting machine from one direction. These patterns are readily selected by shifting the
positions of the butts 7, with the result that knitting operation is remarkably simplified. Since knitting is done by means of a single carriage, the supplementary needle bed coordinated to the main needle bed is not used at all times, whereby the knitting operation is performed easily and smoothly.

What is claimed is:

1. A knitting machine comprising, in combination, a main needle bed formed with parallel needle slots extending longitudinally thereof; a supplementary needle bed formed with parallel needle slots extending longitudinally thereof and moveable into and out of coplanar relation with said main needle bed, the needle slots of both beds being aligned in the coplanar position of the beds; double-hooked needles, having latch-type hooks at each end, reciprocable in said slots; needle operating jacks reciprocable along said slots and having operating butts projecting outwardly therefrom; a carriage reciprocable transversely of one said needle beds and having jack operating cams on its inner surface engageable with the jack butts; each of said jacks including a relatively elongated stem having a contacting surface at one end arranged to engage an end of the associated needle; each jack having a resilient leaf spring extending along one side edge thereof and having a hook end projecting beyond said one end of said stem for engagement in the adjacent latch-type hook of the associated needle; the hook on said leaf spring being displaceable laterally out of the adjacent latch-type hook of the associated needle for passage of a formed stitch over the latch of the needle hook for casting off of the formed stitch; said cams on said carriage being operable on the jack butts, during reciprocation of said carriage, to reciprocate the associated needles to draw fresh yarn and to cast off formed stitches over the drawn fresh yarn; said cams including a stitch removing cam effective to operate the needles, through the jack butts, to cast off stitches; said cams being coöperable in plural combinations thereof to effect plural knitting operations including plain knitting, purl knitting and rib knitting.

2. A knitting machine, as claimed in claim 1, in which said carriage is reciprocable transversely of said main needle bed.

3. A knitting machine, as claimed in claim 1, in which the latch portions of said latch-type needle hooks extend outwardly of said needle slots; said jacks being moveable along the surface of said main needle bed outwardly of said slots.

4. A knitting machine, as claimed in claim 3, including jack guides extending longitudinally of said main needle bed to intermediate said slots and engageable with the lateral edges of said jacks to guide said jacks.

5. A knitting machine, as claimed in claim 1, in which said one ends of said jacks are transversely concave for positive engagement with the ends of the associated needles.

6. A knitting machine, as claimed in claim 4, including cover means extending across and engaging said jack guides and retaining said jacks and said needles against outward displacement relative to said needle beds; the distance between the bottom plane of said needle grooves and the under surface of said cover means being substantially equal to the height of the hooks of said needles as positioned in said slots.

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