WEFT KNITTING MACHINE

A flat knitting machine that can allow reliable selection on the path of a slider without a movable select presser for exclusive use in Split-knit being included in the pressers for pressing a butt of a select jack. When only a trailing Tuck presser 41a is put in the operative mode in position A and a Knit presser 23a is put in the inoperative mode, the selection between Knit provided by the needle selection related to position A and Split-knit provided by the needle selection related to position H can be made. When the Knit presser 23a is switched to the operative mode and also the leading Tuck presser 41b is put to the operative mode, the needle selection related to position H cannot allow the Split-knit, but can allow the selection of Tuck.
Technical Field

[0001] The present invention relates to a flatbed knitting machine using, as knitting compound needles that can allow split knit under operation of sliders.

Background Art

[0002] In general, the flatbed knitting machine having a pair of needle beds arranged in front and back to face each other and define a needle bed gap can provide various knitting operations including the operation of transferring loops between the front needle bed and the back needle bed. Latch needles or compound needles are used as the knitting needles accommodated in their respective needle grooves of the needles beds to be actuated for the knitting. Each compound needle comprises, in general, a slider including two blades, each having a tongue at a portion thereof in the vicinity of its front end on the needle bed gap side, and a needle body having a hook at a front end thereof. This compound needle can allow the hook to be opened or closed and also allow the tongues of the slider to advance into the needle bed gap beyond the hook by relative displacement of the slider, thereby allowing the split knit operation (for example, see Patent Citations 1 and 2).

[0003] In the split knit operation using the compound needle, the operation of forming a new loop by the needle body and the operation of holding an old loop in the needle bed gap by the tongues of the slider are carried out in parallel. The old loop held on the tongues of the slider is taken by the hook of the needle body of the needle on the opposed needle bed. By using the old loop taken to the opposed needle bed in the split knit operation, a knitting width can be increased from inside. When a loop held on the knitting needle located on one side of the knitting width is shifted to one side of the knitting width one by one with respect to the knitting needle as was used for the split knit via the loop transfer and the shift of the needle bed, a knitting needle adjacent to the one side can be made an empty needle. By transferring the old loop taken to the opposed needle bed to the empty needle formed, the knitting width can be increased by one stitch. Such a split knit requires that when the needle body forming a new loop thereon is retracted from the needle bed gap, the slider be kept in position in the needle bed gap. According to Patent Citation 2, the slider is provided with a second butt, in order to prevent a possible awkward behavior of the slider that may follow the needle body retracting from the needle bed gap. The second butt is provided in order that after the split knit operation is selected with the slider being kept in the needle bed gap, the slider can be subjected to a guiding operation of guide cam means for preventing the awkward behavior.

Patent Citation 1: Japanese Patent No. 2917146
Patent Citation 2: Japanese Patent No. 3292836

Disclosure of the Invention

Technical Problem

[0004] Both the compound needle used in Patent Citation 1 and the compound needle used in Patent Citation 2 have, on an opposite side of the needle bed gap, a selector for needle selection, and a select jack for pressing in response to the needle selection. In the both compound needles, the select jack is set at any one of three positions of A, H or B in response to a two-stage needle selection for the selector. These three positions are provided to allow selection of basically three basic knitting operations of the knit, the tuck or the miss for each individual knitting needle. The cam for driving the needle body is supposed to allow the knitting operation of the knit. The knitting operation of the tuck is effected by pressing the butt of the select jack in a zone where the needle body is advanced into the needle bed gap in the knitting operation of the knit. The knitting operation of the miss is effected by pressing the butt of the select jack over an entire zone. In the zone where the butt of the select jack is pressed, the needle body and the drive butt of the slider are sunk in the needle groove under the operation of the select jack, so that the needle body and the slider are not subjected to the driving operation of the cam.

[0005] According to Patent Citation 2, when the three basic knitting operations are performed, a presser for pressing the butt of the select jack is located in the position set to the knit and is moved to a path where the slider is subjected to the operation of the guide cam means in the split knit. In the knitting operation to withdraw the slider together with the needle body, taken as the knitting operation of the knit, the pressing by the presser is not performed. Even if the presser is a movable type one, since an operative mode or an inoperative mode of the presser cannot be changed over for each knitting needle, the split knit have to be carried out at a different position from the knit. As described in Patent Citation 1 and Patent Citation 2, the split knit is performed in the same knitting course as the knit. Due to this, in the case where
the position corresponding to the knit is kept in the basic knitting operation, a split knit presser is disposed in the position corresponding to the tuck. In this case, since the needle body is controlled to do the knitting operation of the knit, not the tuck, in the split knit, a movable type tuck presser must be provided to allow the change over between the knit and the tuck. Likewise, in the case where the split knit presser is provided at the position corresponding to the tuck, the use of the position corresponding to the tuck in the knit requires that the tuck presser must be a movable type one.

[0006] That is, the selection between the knit and the split knit depending on whether the butt of the select jack is pressed or not requires that the movable type presser for exclusive use in the split knit be added and that the tuck presser also be a movable type one. It is known that the movable type presser is used for Tuck and some other movable type pressers are also used to allow various knitting operations. However, the movable type presser requires a space for accommodating an actuator and the like and also the carriage has only a limited interior space for the presser.

[0007] It is an object of the present invention to provide a flatbed knitting machine that can allow reliable change over on the path of the slider without a movable presser for exclusive use to change over on the split knit being included in the pressers for pressing the butt of the select jack.

Technical Solution

[0008] The present invention is a flatbed knitting machine, in which a pair of needle beds arranged in front and back to face each other, defining a needle bed gap between the needle beds, on each needle bed, formed needle grooves in which compound needles accommodated, each compound needle includes a needle body having a hook at a front end thereof on the needle bed gap side and a slider having a tongue at a vicinity of a front end on the needle bed gap side, and is able to allow the hook to be opened or closed and also allow the tongue to advance into the needle bed gap beyond the hook by relative displacement of the slider to the needle body, so that split knit operations are possible, and the slider being provided with a first butt at a portion thereof nearer to the needle bed gap and a second butt at a portion thereof far away from the needle bed gap, the first butt and the second butt being spaced from each other, the flatbed knitting machine comprising:

- a carriage movable in reciprocation along the needle beds, and
- a cam system, for operating the needle body and the slider of the compound needle, being equipped on the carriage, the cam system includes;
- a slider operating cam having a bifurcating portion for guiding the second butt of the slider and bifurcating a path of the slider, depending on whether the second butt is sunk in the needle groove or not, into a first path which allows the slider to be retreated from the needle bed gap together with the needle body and a second path which allows the slider to be kept in position in the needle bed gap even when the needle body is retreated from there, so as to be actuated for the split knit operation, and
- a change over presser which is located at a position in the vicinity of the slider operating cam where the change over presser can press the first butt of the slider when the second butt of the slider engages the bifurcating portion of the slider operating cam, to allow change over between the operative mode of pressing and the inoperative mode of non-pressing.

[0009] In addition, the flatbed knitting machine according to the present invention, wherein said change over presser, in said inoperative mode, even when said needle body is retreated from said needle bed gap, allows said slider to be kept in the needle bed gap, so as to allow the split knit operation.

[0010] In addition, the flatbed knitting machine according to the present invention, wherein said compound needle, on a rear anchor side opposite to said needle bed gap side, has a pressing butt that is subjected to an operation of needle selection by a needle selecting mechanism mounted on said carriage, and to pass through one of a plurality of paths preset in accordance with a result of the needle selection, when the pressing butt being pressed by a pressing presser arranged to confront the paths, a butt for driving said needle body and at least said second butt of the slider are sunk in the needle groove, and

at least one of the pressing pressers is a movable type presser that can allow a change over on the knitting operation of the needle body, depending on whether the pressing presser presses the pressing butt, and the position where said second butt of the slider engages said bifurcating portion of the slider operating cam falls within a range within which the movable type presser is able to press the pressing butt.

[0011] In addition, the flatbed knitting machine according to the present invention, wherein said movable type presser is a tucking presser, by which said needle body is changed over in tucking operation.

[0012] In addition, the flatbed knitting machine according to the present invention, wherein said cam system mounted on the carriage is able to sort stitch values into large-value group and small-value group when said needle body is retracted from said needle bed gap, and
said pressing presser includes a 2nd-stitch presser of a movable type that is able to sort the stitch values into the large-value group and the small-value group.

[0013] In addition, the flatbed knitting machine according to the present invention, wherein said movable type pressing presser is disposed in only one path of a plurality of paths preset in accordance with the result of said needle selection.

Advantageous Effects

[0014] According to the present invention, the compound needles used in the flatbed knitting machine, each including the needle body and the slider and allowing the split knit operation, are accommodated in their respective needle grooves of a pair of needle beds arranged in front and back to face each other and define a needle bed gap. The slider is provided with the first butt at a portion thereof nearer to the needle bed gap and the second butt at a portion thereof far away from the needle bed gap, the first butt and the second butt are spaced from each other. The cam system including the slider operating cam and the change over presser is mounted on the carriage movable in reciprocation along the needle beds. The slider operating cam has the bifurcating portion for guiding the second butt of the slider and bifurcating the path of the slider, depending on whether the second butt is sunk in the needle groove, into the first path which allows the slider to be retracted from the needle bed gap together with the needle body and the second path which allows the slider to be kept in position in the needle bed gap even when the needle body is retracted from the needle bed gap. The change over presser is arranged, the slider can be controlled to perform the slit knit operation. This means that by putting the change over presser into the inoperative mode, the change over presser does not pass through the path along which the pressing presser is arranged, the slider can be retracted from the needle bed gap together with the needle body and the second path which allows the slider to be kept in position in the needle bed gap even when the needle body is retracted from the needle bed gap. The change over presser is made in response to the needle selection by the needle selection mechanism mounted on the carriage, to pass through one of a plurality of paths preset in accordance with the result of the needle selection. At least one of the pressing pressers of movable type presses the pressing butt when the second butt of the slider engages the bifurcating portion of the slider operating cam. Since the change over presser can allow the change over between the operative mode of pressing and the inoperative mode of non-pressing, the change over on the bifurcation at the bifurcating portion can be made in accordance with the presence or absence of the pressing against the first butt of the slider. Accordingly, the need to provide the presser for pressing the butt of the select jack to change over to the split knit can be eliminated. Also, since the change over is made by applying pressure directly to the slider, not to the select jack, the change over can be made reliably with little influence given to the needle body and the like.

[0015] According to the present invention, when the change over presser is put in the inoperative mode and the needle body is retracted from the needle bed gap, the slider is kept in position in the needle bed gap in the split knit.

[0016] According to the present invention, the compound needle has the pressing butt that is subjected to the operation of the needle selection by the needle selection mechanism mounted on the carriage, to pass through one of a plurality of paths preset in accordance with the result of the needle selection. At least one of the pressing pressers of movable type presses the pressing butt when the second butt of the slider engages the bifurcating portion of the slider operating cam. When the needle selection is performed, with the change over presser being in the inoperative mode, so that the pressing butt passes through the path along which the pressing presser is arranged, the slider can be retracted from the needle bed gap together with the needle body. When the needle selection is performed, with the change over presser being in the inoperative mode, so that the pressing presser does not pass through the path along which the pressing presser is arranged, the slider can be controlled to perform the slit knit operation. This means that by putting the change over presser in the inoperative mode, the change over between the split knit and the knitting operation to control the pressing presser can be made in response to the needle selection.

[0017] According to the present invention, the change over of the slider can also be made by the tuck presser as the movable type pressing presser.

[0018] According to the present invention, the switching of the slider can also be made by the 2nd-stitch presser as the movable type pressing presser capable of sorting the stitch values in different stitch-density groups.

[0019] According to the present invention, the pressing pressers of movable type can be all disposed in only one of a plurality of paths preset in accordance with the results of the needle selection, to allow the change over of the knitting operation, so that the remaining paths can be allocated to the fixed knitting operation.

Brief Description of Drawings

[Fig.1] Fig.1 is a combination of a partial side view and a partial plan view to show a main construction of a flatbed knitting machine 1 as one embodiment of the present invention.

[Fig.2] Fig.2 is a partial plan view showing an operation of the flatbed knitting machine 1 of Fig.1.

[Fig.3] Fig.3 is a partial plan view showing an operation of the flatbed knitting machine 1 of Fig.1.

[Fig.4] Fig.4 is a combination of a partial side view and a partial plan view to show a main construction of a flat knitting machine 51 as another embodiment of the present invention.

[Fig.5] Fig.5 is a partial plan view showing an operation of the flat knitting machine 51 of Fig.4.
[Fig.6] Fig.6 is a partial plan view showing an operation of the flat knitting machine 51 of Fig.4.

Explanation of References

[0021]

1, 51 Flatbed knitting machine
2 Compound needle
3, 53 Cam system
10 Needle body
10a Hook
11 Slider
12 Slider base
12a First butt
12b Second butt
13 Blade
13a Tongue
14 Needle jack
14b, 15a Butt
15 Select jack
20, 50 Needle body operating cam
21 Slider operating cam
22, 52 Presser part
23 Knit presser part
23a, 23b Knit presser
39a, 39b Slider bifurcating cam

Best Mode for Carrying Out the Invention

[0022] Fig.1 shows a main construction of a flatbed knitting machine 1 as one embodiment of the present invention. In the flatbed knitting machine 1, compound needles 2 are accommodated in needle grooves of needle beds which are abbreviated to show in the drawing. The needle beds of at least one pair are arranged in front and back to face each other and define a needle bed gap. The compound needles 2 are driven by a cam system 3 mounted on a ground plate of a carriage which is moved perpendicular to the needle grooves along the needle beds. The cam system 3 can perform basic knitting operations of the knit, the tuck, and the miss, and an operation of a slider for the split knit. The cam system 3 is configured to be symmetrical on both sides with respect to a center line 3a, so that when the cam system is moved in one direction or another of both lateral sides, the same operations of the compound needles 2 can be performed in the same manner. The carriage is provided, at both sides of the cam system 3, with another cam system for allowing the operation on the loop transfer, though the cam system are abbreviated to show in the drawing.

[0023] For explanatory convenience, the compound needle 2 arranged on the left side of the cam system 3 is illustrated. In the flatbed knitting machine 1, the ground plate of the carriage mounting the cam system 3 thereon is disposed to face the needle grooves accommodating the compound needles 2 therein. In Fig.1, the upper side of the paper surface of the drawing is the direction to move nearer to the needle bed gap, and the lower side of the same is the direction to move away from there. The right side of the paper surface of the drawing is the direction for the compound needle 2 to rise up in the needle groove, and the left side of the same is the direction for the compound needle 2 to sink down in the needle groove. A height in relation to the cam system 3 corresponds to a height with respect to the direction of projecting vertically from the paper surface of the drawing, and a height in relation to the needle groove corresponds to a sinking direction.

[0024] A front end portion of the compound needle 2 is illustrated which is in the state of being accommodated in the needle groove, with its bottom facing to the left side. The compound needle 2 includes a needle body 10 and a slider 11. The needle body 10 has a hook 10a at a front end thereof on the needle bed gap side and has a recess 10b at a tail portion thereof. The slider 11 is formed of combination of a slider base 12 and two blades 13. The slider base 12 has a first butt 12a and a second butt 12b projecting upwardly in spaced relation from each other. The first butt 12a is located at a position nearer to the hook 10a side than the second butt 12b or nearer to the needle bed gap and is lower than the second butt 12b in height extending from the needle groove. In the case where the slider base 12 is solely
provided with a single butt, the second butt 12b corresponds to such a single butt. The blade 13 has a tongue 13a formed at a front end portion thereof, and the tongue 13a is associated with the slider base 12 to open or close the hook 10a at the front end. The slider 11 can allow the tongue 13a to advance toward the front end beyond the hook 10a.

[0025] A front projection 14a of the needle jack 14 is fitted in the recess 10b in a tail portion of the needle body 10. The needle jack 14 has, at a nearly intermediate portion thereof, the butt 14b projecting from the needle groove, and also has, at a tail portion thereof, an elastic leg 14c bendable to contact to a bottom of the needle groove. The butt 14b is biased by the resilience of the elastic leg 14c, to rise in the needle groove and from the bottom of the needle groove. The tail portion of the slider base 12 is accommodated in a space defined between an arm formed to extend from the butt 14b of the needle jack 14 toward the front end and an extended portion of the elastic leg 14c. This tail portion is biased by a lug provided in the extended portion so that the first butt 12a and the second butt 12b come out from the needle groove. When the needle jack 14 sinks in the needle groove, the tail portion of the slider base 12 is also bent by the pressing from the arm of the needle jack 14, so that at least the second butt 12b also sinks in the needle groove.

[0026] The elastic leg 14c of the needle jack 14 is subjected to the pressing from the front end portion of a select jack 15. The select jack 15, only a front end portion of which is shown, is subjected to the action of the needle selection on the selector and the like of the compound needle 2 provided on the side farther away from the tail portion, whereby the pressing butt 15a is shifted to any one of three positions A, B, or H.

[0027] The cam system 3 includes a needle body operating cam 20, a slider operating cam 21, a presser part 22, and a knit presser part 23. The needle body operating cam 20, which includes a raising cam 30, a bridge cam 31, and stitch cams 32a, 32b, drives the butt 14b of the needle jack 14.

[0028] The needle jack 30 advances the needle body 10 toward the needle bed gap. The top of the raising cam 30 is divided into two top portions 30a, 30b. The two top portions 30a, 30b are formed at positions symmetrical with respect to a center line 3a, projecting from a flat shoulder portion 30c toward the bridge cam 31. The shoulder portion 30c and outer fringes of the top portions 30a, 30b have a full height or a maximum height in relation to the cam system 3 with respect to the direction of facing to the needle bed from a surface of the ground plate of the carriage. The parts having the full height are depicted by orthogonal broken lines. Inner parts of the top portions 30a, 30b facing to each other have slant surfaces varying in height from the ground plate of the carriage to the full height, as depicted by oblique lines. Diagonal lines falling from upper left to lower right indicate that the left side is higher in level than the right side. Diagonal lines falling from upper right to lower left indicate that the left side is lower in level than the right side. The shoulder portion 30c includes therein an intermediate portion 30d of half height lower than the full height. The portion having the full height is depicted by distributed dots. The raising cam 30 includes a base portion 30e of full height at the bottom.

[0029] A path for the knit, along which the butt 14b of the needle jack 14 is guided, is formed between upper edges of the top portions 30a, 30b of the raising cam 30 and a lower edge of the bridge cam 31. This path declines along the declinations on the both sides of the raising cam 30. The needle body 10 is pulled down along this path by the butt 14b being guided by the inner slant surfaces of the stitch cams 32a, 32b. The stitches cams 32a, 32b, which are sometimes referred to as pulling cams, can adjust the pulling quantity of the needle body 10 by varying stitch density value.

[0030] The slider operating cam 21 includes slider guide cams 35, 36a, 36b, a slider raising cam 37, slider holding cams 38a, 38b, and slider bifurcating cams 39a, 39b. The slider guide cam 35 is disposed at the center and the slider guide cams 36a, 36b are disposed at the both lateral sides, each slider guide cam having a half height. The slider raising cam 37 is disposed under a center portion of the slider guide cam 35 and has a full-height portion and a slant surface. The slider raising cam 37 guides the second butt 12b of the slider base 12 in such a manner as to allow the second butt 12b to rise up toward the needle bed gap along the periphery of the both lateral portions of full height. The slider holding cams 38a, 38b of full height are disposed under the right and left slider guide cams 36a, 36b, respectively. The slider bifurcating cams 39a, 39b which act as the bifurcating portion for the second butt 12b are disposed under the slider guide cam 35 and on both lateral sides of the slider raising cam 37, respectively.

[0031] The slider bifurcating cam 39a, 39b has a bifurcating portion of half height for guiding the second butt 12b to the upper side of the laterally extending portion of full height along the periphery, and a slant surface extending continuously to the bifurcating portion. When the second butt 12b is guided along the periphery of the bifurcating portion, it is further moved laterally along the periphery of the slant surface and is guided into the path between the slider guide cams 36a, 36b and the slider holding cams 38a, 38b.

[0032] As depicted by vertically extending chain double-dashed lines in the drawing, knit pressers 23a, 23b of the knit presser part 23 able to act on the first butt 12a are disposed on the same phase lines extending through the positions where the second butt 12b of the slider base 12 engage the bifurcating portions of the slider operating cams 39a, 39b. Movable type pressers are used for the right and left knit pressers 23a, 23b, respectively, so as to allow changeover between the full-line operative position and the broken-line inoperative position in at least the following side. In this illustrated embodiment, a single solenoid is used as a shared driving source to operate the right and left knit pressers 23a, 23b in association, so as to make the changeover. The knit pressers 23a, 23b are each provided with a portion of full height to press the first butt 12a in the operative position. When the first butt 12a is pressed, the second butt 12b sinks in the needle groove and moves across the bifurcating portion of half height of the slider bifurcating cam 39a, 39b.
The second butt 12b is not guided to move along the periphery of the slider bifurcating cam 39a, 39b, but bifurcated to shift to the slant surface. The second butt 12b shifted to the slant surface is guided along a slanted guide portion formed at a lower portion of the slider holding cam 38a, 38b and is pulled down to retract from the needle bed gap.

[0033] The presser part 22 has a fixed miss presser 40 in the path of the position B and movable tuck pressers 41a, 41b in the path of the position A. No presser is provided in the path of the position H. The movable tuck pressers 41a, 41b are disposed at both sides of the center line 3a. The tuck pressers are independent, movable pressers that can allow the changeover between the full-line operative position and the broken-line inoperative position. When the select jack 15 is set to the position B by the needle selection, the butt 15a is pressed by the miss presser 40, so that the select jack 15 is sunk in the needle groove. Then, the butt 14b of the needle jack 14 and the second butt 12b of the slider base 12 are also sunk in the needle groove, so that the butt 14b and the second butt 12b are not subjected to the action of the needle body operating cam 20 and the slider operating cam 21. As a result of this, the knitting operation of the miss is performed by the compound needle 2.

[0034] Figs.2 and 3 show the operation performed by the flatbed knitting machine 1 of Fig.1 when the carriage moves leftwards. The same operation is performed when the carriage moves rightwards, as well.

[0035] Fig.2 shows the operation that can be provided by the needle selection to change over between the knit and the split knit. A full-line trajectory shows a common part and a part corresponding to the split knit. A broken-line trajectory shows a part corresponding to the needle. The knit is selected by the needle selection in relation to the position A. The split knit is selected by the needle selection in relation to the position H. Of the two tuck pressers 41a, 41b disposed along the path of the position A, the leading tuck presser 41b is made inoperative and the following tuck presser 41a is made operative. The knits pressers 23a, 23b are set to the inoperative position.

[0036] When the select jack 15 is set to the position H by the needle selection, the butt 15a is not subjected to the pressing action of the presser while passing through the trajectory 15aH. The butt 14b of the needle jack 14 is guided along the periphery of the raising cam 30 including the leading top portion 30b and passes through a mountain-shaped route as shown as the trajectory 14bH&A. With the butt guided along the periphery of the top portion 30b, the hook 10a of the needle body 10 is advanced into the needle bed gap beyond the tongue 13a of the blade 13. If the hook 10a holds a stitch loop therein, then the stitch loop will be cleared from the hook 10a and moved to the tongue 13a.

[0037] When passing the top portion 30b, the butt 14b of the needle jack 14 is moved downwards along the downward mountain-shaped periphery provided at a center portion thereof under the bridge cam 31. As engaging the slant surface of the following top portion 30a of the raising cam 30, the butt 14b passes over the slant surface and moves rightwards, without being guided along the periphery of the raising cam. When engaging leg portions of the bridge cam at both lower sides thereof and a guide portion of the stitch cam 32a, the butt 14b is guided via a downward slant path, whereby the hook 10a is retracted from the needle bed gap. If a yarn feeding member, such as a yarn feeder, continues to follow the carriage, then a yarn will be fed through the hook 10a before the hook 10a is retracted from the needle bed gap. Then, when the butt 14a is forced to move downward by the guide portion of the stitch cam 32a, to retract the hook 10a from the needle bed gap, a new loop is formed by the yarn fed through the hook 10a. The new loop is formed in the hook 10a, while on the other hand, the loop moved to the tongue 13a comes to be an old loop.

[0038] When the select jack 15 is set to the position A by the needle selection, the butt 15a is subjected to the action of the tuck presser 41a and as a result, the butt 14b of the needle jack 14 is sunk in the needle groove. In this regard, however, this zone is a zone for the butt 15a to engage the trailing top 30a. Even when the butt 15a is sunk in the needle groove, the butt 14a passes through the same path as that of position H, as shown as the track 14bH&A. This means that the needle body 10 provides the same knitting operation in position A as well as in position H.

[0039] In either needle selection in relation to position A or H, when the butt 14b of the needle jack 14 is raised up toward the needle bed gap via the raising cam 30, the slider base 12 is also pushed up. The second butt 12b of the slider base 12 passes through a space between the slider bifurcating cam 39b and the slider raising cam 37 and is raised up toward the needle bed gap along the periphery of a left-side portion of the slider raising cam 37. The second butt 12b is moved downwards slightly at a center of a lower edge of the slider guide cam 35. The second butt 12b passes across the right-side slant face of the slider raising cam 37 transversely and arrives at the bifurcating portion of the slider bifurcating cam 39a.

[0040] The butt 15a of the select jack 15 in position H is not subjected to the pressure by the presser at the bifurcating portion. Since the first butt 12a of the slider base 12 is not subjected to the pressure by the Knit pressure 23a, either, the second butt 12b is guided along the periphery of the bifurcating portion of the slider bifurcating cam 39a and led into a route defined between the slider guide cam 36a and the slider holding cam 38a. The slider 11 is held in the state of the tongue 13a being advanced into the needle bed gap along the full-line path 12bH, and the old loop is held with the tongue 13a advanced into the needle bed gap. The old loop held on the tongue 13a is transferred to the hook 10a advanced into the needle bed gap from the opposed needle bed in the following knitting course and is released from the tongue 13a. Thus, the Split-knit can be performed.

[0041] When the butt 15a of the select jack 15 is set to position A by the needle selection, the butt 15a is pressed by the Tuck presser 41. As a result of this, the second butt 12b of the slider base 12 is guided along the broken-line path.
12bA and is retracted from the needle bed gap in response to the knitting operation of Knit. When the slider base 12 is retracted from the needle bed gap, the old loop held on the tongue 13a is released from the front end of the blade 13 (knock-over). The first butt 12a of the slider base 12 is moved along the path 12aH, 12aA corresponding to the path 12bH, 12bA of the second butt 12b, respectively.

[0042] As shown in FIG. 2, when only the trailing Tuck presser 41a is made operative in position A and the Knit presser 23a is made inoperative, the selection between Knit and Split-knit can be made. More specifically, the needle selection in relation to position A and the needle selection in relation to position H can allow the selection of the knitting operation of Knit and the selection of the operation of Split-knit, respectively, for each knitting needle. Also, since the second butt 12b of the slider base 12, when switched to the path of Split-knit, is guided along the upper periphery of the slider bifurcating cam 39a, 39b, a possible awkward behavior of the slider that may follow the needle body 10 when retracted from the needle bed gap can also be prevented.

[0043] FIG. 3 shows the operation that can allow the selection between Knit and Tuck without the operation of Split-knit. In position A, the two Tuck pressers 41a, 41b are both made operative. The Knit presser is also made operative. The path 14bH, along which the butt 14b of the needle jack 14 moves when the select jack 15 is set to position H by the needle selection, runs through a mountain-shaped route along the leading top 30b of the raising cam 30. The path 14bA of the butt 14b in position A is maintained at a shoulder level after passing over the top 30b. The path 14bH&A along which the butt 14b passes over the trailing top 30a and then moves downwards along the slant of the stitch cam 32a is common.

[0044] In accordance with the presence or absence of the pressing by the Tuck presser 41b, the path of the butt 14b of the needle jack 14 is switched to the path 14bH or the path 14bA in relation to the leading top 30b of the raising cam 30. In response to this, the path of the second butt 12b of the slider base 12 is also switched to the path 12bH or the path 12bA. In the broken-line path 12bA, since the needle body 10 is not advanced into the needle bed gap until the stitch loop held by the hook 10a is cleared, the slider 11 is not driven to advance into the needle bed gap, either. In the full-line path 12aH, as the hook 10a is advanced to the needle bed gap to clear the stitch loop, the slider 11 is also advance to the needle bed gap. Therefore, the first butt 12a is pressed by the Knit presser 23a at the bifurcating portion of the slider bifurcating cam 39a, so that the slider 11 is moved downward along the path 12bA along which the slider 11 is retracted from the needle bed gap.

[0045] In short, the needle selection related to position H can allow the knitting operation of Knit, and the needle selection related to position A can allow the knitting operation of Tuck. In position B, the knitting operation of Miss is provided. Thus, the three basic knitting operations of Knit, Tuck, Miss can be selected by controlling the Knit presser 23a. If only the switching of the three knitting operations is required, fixed pressers may be used for the Tuck pressers 41a, 41b. But, if the switching of Split-knit as well is required, then at least the Tuck presser must be a movable type one. Without using the movable type Tuck pressers 41a, 41b and the movable type Knit pressers 23a, 23b in combination, both the selection of Split-knit shown in FIG. 2 and the selection between Knit and Tuck without the Split-knit operation shown in FIG. 3 cannot be provided.

[0046] FIG. 4 shows the construction of a main part of a flat knitting machine 51 of another embodiment of the present invention. In FIG. 4, like reference characters refer to corresponding parts in FIG. 1 and overlap explanation thereon may be omitted.

[0047] The flat knitting machine 51 uses the same compound needles as those used in the flat knitting machine 1. The flat knitting machine 51 is different from the flat knitting machine 1 in arrangement of a needle body operating cam 50 and a presser portion 52 that can allow the selection of the 2nd-stitch. For this, a movable base 61 of half height and a movable 2nd-stitch portion 62 of full height are used for stitch cams 60a, 60b of a cam system 53 mounted on the carriage. As shown as the stitch cam 60b at the left side of FIG. 4, when the 2nd-stitch portion 62 corresponds in position to a lower end of the base 61, a zero 2nd-stitch difference is provided. When the zero 2nd-stitch difference is provided, the pulling of the needle body 10 is performed substantially in correspondence with only a single stitch value, just as in the case of the stitch cams 32a, 32b of FIG. 1. As shown as the stitch cam 60a at the right side of FIG. 4, when the 2nd-stitch portion 62 is shifted from the lower end of the base 61, the 2nd-stitch knitting operation can be provided. In this regard, however, in position A for the butt 15a of the select jack 15, movable 2nd-stitch pressers 63a, 63b are added at both sides of the Tuck pressers 41a, 41b.

[0048] FIGS. 5 and 6 show a main operation of the flat knitting machine 51 of FIG. 4 performed when the carriage is moved leftwards. It is noted in this regard that when the movable 2nd-stitch pressers 63a, 63b are made inoperative and the stitch cams 60a, 60b are set to provide a zero 2nd-stitch difference, the flat knitting machine 51 can provide the same operations including Split-knit as the flat knitting machine 1 of FIG. 1 does.

[0049] FIG. 5 shows the knitting operation in which stitch values are sorted in different stitch-density groups of loose stitch and normal stitch. The presser in position H puts the leading 2nd-stitch presser 63b and the Tuck presser 41b in the inoperative position and also puts the trailing Tuck presser 41a and the 2nd-stitch presser 63a in the operative position. The Knit presser 23a is put in the operative position.

[0050] As shown as the path 12bH&A, the second butt 12b of the slider base 12 passes through the common path...
when the select jack 15 is in position H as well as in position A. More specifically, the tongue 13a of the slider 11 after advanced into the needle bed gap is retracted therefrom a short time later. In position H, only the pressing on the first butt 12a by the Knit presser 23a is performed at the position where the second butt 12a engages the bifurcating portion of the slider bifurcating cam 39a. In position A, the pressing on the butt 15a of the select jack 15 by the trailing Tuck presser 41 is also added. In either position, when engaging the bifurcating portion of the slider bifurcating cam 39a, the second butt 12b passes over the bifurcating portion of half height and then is guided to the path along which the slider 11 is moved downwards.

[0051] The operation of selecting a stitch value by changing a dragged-down rate of the needle body 10 is performed by the 2nd-stitch presser 63a that can act on in position A. In position H, the butt 14b of the needle jack 14 is moved downwards to a lower end of the base portion 61 of the stitch cam 60a along the periphery thereof, as shown in the full-line path 14bH. In position A, the butt 14b is just moved downwards to the lower end of the 2nd-stitch portion 62 of full height, passing across the base portion 61 of half height, as shown in the broken-line path 14bA.

[0052] FIG. 6 shows the operation to select between Knit and Tuck with 2nd-stitch. In position A, the leading 2nd-stitch presser 63b is made inoperative, and the leading Tuck presser 41b, the trailing Tuck presser 41a, and the trailing 2nd-stitch presser 63a are made operative. The Knit presser 23a is also made operative. In position H, the needle body 10 and the slider 11 perform a corresponding knitting operation to Knit in accordance with the full-line paths 14bH, 12bH. In position A, in correspondence to the broken-line path 14bH, the needle body 10 passes across the leading top 30b of the raising cam 30 to perform the operation of Tuck, and passes across the base 61 at the stitch cam 60a to perform the operation of 2nd-stitch. In short, in position A, the knitting operations of Tuck and 2nd-stitch are performed. In the operation of Knit, the slider 11 is moved downwards after advanced into the needle bed gap, as shown in the full-line path 12bH, while on the other hand, in the operation of Tuck, the slider 11 is not advanced into the needle bed gap, as shown in the broken-line path 12bA.

[0053] The cam system 3 of FIG. 1 and the cam system 53 of FIG. 4 do not include any loop-transfer cam. The construction of the cam system 3, 53 can allow the old loop to be held in the needle bed gap via the tongue 13a of the slider 11, which is taken as a previous step of Split-knit, but cannot allow the old loop to be taken to the opposed needle bed. In this embodiment, the trailing cam system is provided with the loop-transfer cam, to provide the operations of Split-knit and Loop-transfer. If the cam system 3, 53 is improved to include the loop-transfer cam, as in the case of FIG. 5 of Patent Document 2, then the Split-knit cam and the Loop-transfer cam can be used in combination.

[0054] For example, if a presser is provided in the path of position H in relation to the butt 15a of the select jack 15 and in the corresponding phase to that of the slider bifurcating cams 39a, 39b, then there will be no need to provide the Knit presser portion 23. In this case, however, many pressers will be collectively provided in the presser portion 22, 52, so that the presser portion 22, 52 will be of densely-arranged. The Knit pressers 23a, 23b are provided, separately from the presser portion 22, 52 that acts on the butt 15a of the select jack 15, so as to act on the first butt 12a of the slider base 12. Thus, the presser portion 22, 52 in relation to the Split-knit can be simplified in arrangement. Also, since the Knit pressers 23a, 23b are made to act directly on the first butt 12a of the slider base 12, the second butt 12b of the slider base 12 can be sunk in the needle groove with little influence given to the needle jack 14.

Claims

1. A flatbed knitting machine, in which a pair of needle beds arranged in front and back to face each other, defining a needle bed gap between the needle beds, on each needle bed, formed needle grooves in which compound needles accommodated, each compound needle includes a needle body having a hook at a front end thereof on the needle bed gap side and a slider having a tongue at a vicinity of a front end on the needle bed gap side, and is able to allow the hook to be opened or closed and also allow the tongue to advance into the needle bed gap beyond the hook by relative displacement of the slider to the needle body, so that split knit operations are possible, and the slider being provided with a first butt at a portion thereof nearer to the needle bed gap and a second butt at a portion thereof far away from the needle bed gap, the first butt and the second butt being spaced from each other, the flatbed knitting machine comprising:

a carriage movable in reciprocation along the needle beds, and
a cam system, for operating the needle body and the slider of the compound needle, being equipped on the carriage,
the cam system includes;

a slider operating cam having a bifurcating portion for guiding the second butt of the slider and bifurcating a path of the slider, depending on whether the second butt is sunk in the needle groove or not, into a first path which allows the slider to be retreated from the needle bed gap together with the needle body and a second
path which allows the slider to be kept in position in the needle bed gap even when the needle body is retreated from there, so as to be actuated for the split knit operation, and
a change over presser which is located at a position in the vicinity of the slider operating cam where the change over presser can press the first butt of the slider when the second butt of the slider engages the bifurcating portion of the slider operating cam, to allow change over between the operative mode of pressing and the inoperative mode of non-pressing.

2. The flatbed knitting machine according to claim 1,
wherein said change over presser, in said inoperative mode, even when said needle body is retreated from said needle bed gap, allows said slider to be kept in the needle bed gap, so as to allow the split knit operation.

3. The flatbed knitting machine according to claims 1 or 2,
wherein said compound needle, on a rear anchor side opposite to said needle bed gap side, has a pressing butt that is subjected to an operation of needle selection by a needle selecting mechanism mounted on said carriage, and to pass through one of a plurality of paths preset in accordance with a result of the needle selection, when the pressing butt being pressed by a pressing presser arranged to confront the paths, a butt for driving said needle body and at least said second butt of the slider are sunk in the needle groove, and at least one of the pressing pressers is a movable type presser that can allow a change over on the knitting operation of the needle body, depending on whether the pressing presser presses the pressing butt, and the position where said second butt of the slider engages said bifurcating portion of the slider operating cam falls within a range within which the movable type presser is able to press the pressing butt.

4. The flatbed knitting machine according to claim 3,
wherein said movable type presser is a tucking presser, by which said needle body is changed over in tucking operation.

5. The flatbed knitting machine according to claims 3 or 4,
wherein said cam system mounted on the carriage is able to sort stitch values into large-value group and small-value group when said needle body is retracted from said needle bed gap, and said pressing presser includes a 2nd-stitch presser of a movable type that is able to sort the stitch values into the large-value group and the small-value group.

6. The flatbed knitting machine according to any one of claims 3-5,
wherein said movable type pressing presser is disposed in only one path of a plurality of paths preset in accordance with the result of said needle selection.
# INTERNATIONAL SEARCH REPORT

**International application No.**  
PCT/JP2008/002451

## A. CLASSIFICATION OF SUBJECT MATTER

D04B15/36(2006.01)i, D04B7/00(2006.01)i, D04B15/82(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D04B7/00-7/34, 15/36, 15/82

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996  
Jitsuyo Shinan Toroku Koho 1996-2008  
Kokai Jitsuyo Shinan Koho 1971-2008  
Toroku Jitsuyo Shinan Koho 1994-2008

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>A</td>
<td>JP 3292836 B2 (Shima Seiki Mfg., Ltd.), 17 June, 2002 (17.06.02), &amp; EP 955401 A2</td>
<td>1-6</td>
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</table>

Further documents are listed in the continuation of Box C.

- **T** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- **X** document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- **Y** document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- **A** document member of the same patent family

**Date of the actual completion of the international search**  
24 September, 2008 (24.09.08)

**Date of mailing of the international search report**  
07 October, 2008 (07.10.08)

**Name and mailing address of the ISA**  
Japanese Patent Office

**Fax/telephone No.**
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<td>A</td>
<td>JP 6-84583 B2 (Shima Seiki Mfg., Ltd.), 26 October, 1994 (26.10.94), (Family: none)</td>
<td>1-6</td>
</tr>
</tbody>
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description