



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.03.2013 Bulletin 2013/12

(51) Int Cl.:
D04B 15/36 (2006.01) D04B 35/06 (2006.01)

(21) Application number: **12006424.1**

(22) Date of filing: **13.09.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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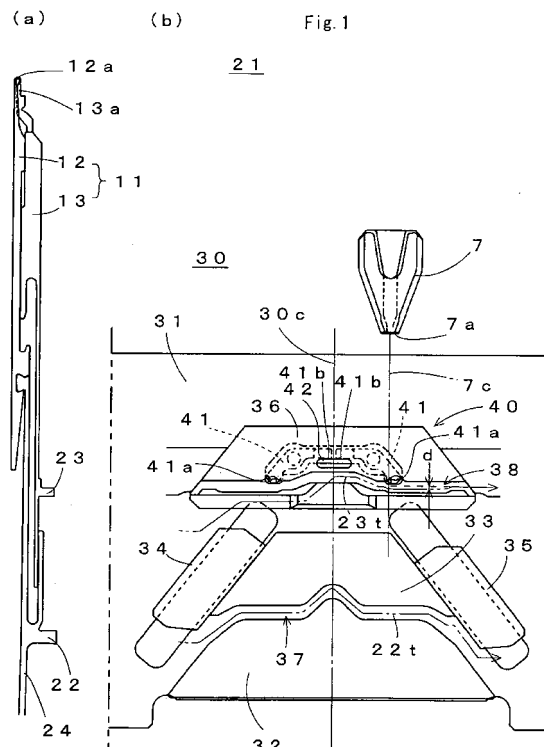
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(30) Priority: **13.09.2011 JP 2011199173**

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(54) **Flatbed knitting machine provided with compound needle, and slider control method for flatbed knitting machine**

(57) [Problem to be solved] It is an object of the present invention to provide a flatbed knitting machine, which is provided with compound needles, to be capable of making old stitches hardly to drop into hooks from tongues and also of making a knitting yarn which is to be caught in the hook in order to form a new stitch hardly to get caught on the tongue, and also to provide a method for controlling a slider of the flatbed knitting machine. [Solution] When a needle driving butt 22 is moved along a trajectory 22t and a hook 12a is thereby advanced into a needle bed gap 2, a tongue 13a opens a hook mouth of the hook 12a, so that an old stitch which has been formed in the hook 12a is transferred onto the tongue 13a and cleared from the hook 12a. When the hook 12a is withdrawn toward the needle bed 3, 4 side, a knitting yarn is fed from a yarn feeder port 7a so as to pass within a range through which a hook mouth of the hook 12a passes and caught in the hook 12a. A movable cam mechanism 40 provided in a slider cam 36 can produce a difference d in the position of the tongue 13a by switching action or inaction of a control portion 41a of a cam member 41 on a slider driving butt 23 near a centerline 7c.



Description

[Technical Field]

[0001] The present invention relates to a flatbed knitting machine provided with compound needles, each compound needle is formed by combining a needle body and a slider, and knits a fabric by opening and closing a hook of the needle body by a tongue of the slider, and a control method for the slider of the flatbed knitting machine.

[Background Art]

[0002] Conventionally, it is possible to use compound needles as knitting needles in a flatbed knitting machine which is provided with needle beds at front and rear thereof (See Patent Literature 1, for example). Figs. 7 simplistically show a state in which a fabric is knitted by a flatbed knitting machine 1. Needle grooves 5 are formed in each of a pair of needle beds 3,4 which are opposed to each other with respect to a needle bed gap 2. Each of the needle grooves 5 is formed in an inclined manner such that one side thereof close to the needle bed gap 2 is positioned higher than the other side thereof away from the needle bed gap 2. Further, the needle grooves 5 are arranged in the direction perpendicular to the sheet on which the figures are drawn. A needle plate and a sinker 5a are provided between the needle grooves 5, and in the vicinity of a head end of the sinker 5a at the needle bed gap side, a wire 6 as a top tooth penetrates in the direction perpendicular to the sheet of the figure. Above the needle bed gap 2, a yarn feeder 7 moves in the direction perpendicular to the sheet surface on which the figure is drawn, and feeds a knitting yarn 8 from a yarn feeder port 7a. In the flatbed knitting machine 1, it is possible to knit fabrics having different structures by selectively using the needle beds 3,4, fig. 7(a) shows a case in which a plain knit fabric 9 and the like is knitted by using only the needle bed 3. and fig. 7(b) shows a case in which a rib knit fabric 10 and the like is knitted by using both of the needle beds 3, 4, respectively.

[0003] In each needle groove 5, a compound needle 11 is put in as a knitting needle. In the compound needle 11, a needle body 12 is combined with a slider 13. On the needle body 12 which has a hook 12a at a head end thereof, further a slider groove 12b is also formed. The slider 13 is partially put in the slider groove 12b and makes a slide move with respect to the needle body 12 so as to open and close a hook mouth of the hook 12a by a tongue 13a which is formed in a head end of the slider 13.

[0004] In case that the plain knit fabric 9 is knitted as shown in Fig. 7(a), the hook 12a is advanced into the needle bed gap 2 only from one needle bed 3, and then, when the hook 12a is withdrawn into the needle bed 3, the knitting yarn 8, which is fed from the yarn feeder port 7a and passes within a range through which the hook

mouth of the hook 12a passes, is caught in the hook 12a. An old stitch 9a is cleared from inside of the hook 12a when the hook 12a is advanced into the needle bed gap 2, moves onto the tongue 13a of the slider 13 waiting on the needle bed 3 side, and is retained therein. In case that the rib knit fabric 10 is knitted as shown in Fig. 7(b), the hooks 12a are, for example, alternately advanced into the needle bed gap 2 from both needle beds 3, 4, to thereby catch the knitting yarn 8, and then an old stitch 10a moves onto the tongue 13a after being cleared from the hooks 12a.

[0005] While retaining the old stitch 9a or 10a on the tongue 13a, the hook 12a is further withdrawn into the needle bed 3, 4, the hook mouth of the hook 12a is closed by the tongue 13a, and then the needle body 12 and the slider 13 are further withdrawn into the needle bed 3,4, so that as a result, the old stitch 9a or 10a is knocked over to form the plain knit fabric 9 or the rib knit fabric 10 and hangs down in the needle bed gap 2, and a new stitch is formed in the closed hook 12a. The advancement and withdrawal of the needle body 12 or the slider 13 into and from the needle bed gap 2 is driven by a cam mechanism which is mounted on a carriage which runs back and forth in the direction perpendicular to the sheet surface on which the figure is drawn, and arranged so as to face each of the needle beds 3, 4. The yarn feeder 7 moves in synchronization with the carriage. The plain knit fabric 9 or the rib knit fabric 10 is knitted by repeating such operations of the carriage and the yarn feeder 7.

[Citation List]

[Patent Literature]

[0006]

[Patent Literature 1] Japanese Patent No. 3085657

[Summary of Invention]

[Technical Problem]

[0007] In order to catch the knitting yarn 8 in the hook 12a which is advanced into the needle bed gap 2 and then withdrawn into the needle bed 3,4, and let the old stitch 9a or 10a be knocked over to reliably form a new stitch, it is necessary to feed the knitting yarn 8 so as not to get caught on the tongue 13a. Further, when feeding the knitting yarn 8, it is necessary to retain the old stitch 9a or 10a on the tongue 13a. As shown in Fig. 7(a), the plain knit fabric 9 which is knitted by using the needle bed 3 at one side of the needle bed gap 2 hangs down at a position closer to the needle bed 3 than the vicinity of the center of the needle bed gap 2. On the other hand, as shown in Fig. 7(b), the rib knit fabric 10 which is knitted by using the needle beds 3, 4 at both sides of the needle bed gap 2 hangs down near the center of the needle bed gap 2. When the knitting is finished with respect to one

course of the plain knit fabric 9 or the rib knit fabric 10, the knitting yarn 8 has moved out of the knitting width from an end stitch at a termination side of the knitting and crosses over to the yarn feeder 7 so as to serve as a cross-over yarn. This cross-over yarn, crosses over to the yarn feeder 7, becomes the knitting yarn 8 that is fed when the carriage is inverted so that the termination side in an old course becomes a starting point side in a new course and a first stitch of the new course is formed. The cross-over yarn, which crosses over to the yarn feeder 7, is in a state of being folded back from the old stitch 9a or 10a retained on the tongue 13a, and passes through the position closer to the needle bed 3 in the plain knit fabric 9 or passes through the position closer to the center of the needle bed gap 2 in the rib knit fabric 10. Such a difference in the position through which the knitting yarn 8 passes arises not only for end stitches of the knitting width but also for end portions of a section in which intarsia knitting is performed within the knitting width, or when a new stitch is knitted by performing a kick back of the yarn feeder 7.

[0008] In a waiting position of the slider 13 as shown in Figs. 7, it is possible to reliably catch the knitting yarn 8 in the hook 12a while reliably retaining the old stitch 9a on the tongue 13a in the plain knit fabric 9 of Fig. 7(a). In the rib knit fabric 10 of Fig. 7(b), since the position of the fed knitting yarn 8 is away from the tongue 13a compared to the case in the plain knit fabric 9, it becomes possible to catch the knitting yarn 8 in the hook 12a more reliably. However, the old stitch 10a of the rib knit fabric 10 which hangs down near the center of the needle bed gap 2 is retained at a high position which is close to the needle bed gap 2 compared to the retained position of the old stitch 9a of the plain knit fabric 9. Namely, the old stitch 10a is retained in the vicinity of a head end position of the tongue 13a. However, since there is not enough room in the vicinity of the head end position of the tongue 13a, the old stitch 10a may drop into the hook 12a again depending on conditions such as high knitting speed. In order to make the old stitch which has once been cleared unlikely to drop into the hook 12a, it might be thought to adjust the position of the tongue 13a so as to be advanced toward the needle bed gap 2. However, when knitting the plain knit fabric 9 and the like, the knitting yarn 8 may get caught in the tongue 13a which has been advanced toward the needle bed gap 2, thereby making it difficult to catch the knitting yarn 8 in the hook 12a.

[0009] It is an object of the present invention to provide a flatbed knitting machine, which is provided with compound needles, to be capable of making old stitches hardly to drop into hooks from tongues and also of making a knitting yarn which is to be caught in the hook in order to form a new stitch hardly to get caught on the tongue, and also to provide a method for controlling a slider of the flatbed knitting machine.

[Solution to Problem]

[0010] The present invention provides a flatbed knitting machine provided with compound needles, each compound needle being formed by combining a needle body and a slider, the needle body having a hook at a head end thereof, and the slider making slide movement with respect to the needle body and having a tongue at a head end thereof, the tongue opening and closing the hook, so that a needle driving butt of the needle body and a slider driving butt of the slider are driven by a cam system so as to catch a knitting yarn in the hook when the hook is advanced into a needle bed gap and then withdrawn into the needle bed,

characterized in that

the flatbed knitting machine includes

a movable cam mechanism, which fronts a section corresponding to a trajectory of a knitting route through which the slider driving butt passes in a knit operation when catching the knitting yarn in the hook, and being capable of controlling a position of the slider by acting on the slider driving butt into a high position in a direction to be advanced into the needle bed gap for making an old stitch retained in the tongue hardly to drop into the hook, or a low position in a direction to be withdrawn from the needle bed gap for making the knitting yarn fed from a yarn feeder hardly to get caught on the tongue.

[0011] Further, in the present invention, said movable cam mechanism includes a cam member capable of switching the position of said slider into two stages by controlling action or inaction on said slider driving butt, in said section corresponding when the slider driving butt being positioned to catch the knitting yarn in said hook.

[0012] Further, in the present invention, said cam member has a lever shape, and is provided with a control portion for performing control on said slider driving butt at one end thereof and a drive portion to receive driving for the control at the other end thereof, being supported at an intermediate position between the control portion and the drive portion so as to be capable of rocking displacement, and

the movable cam mechanism includes an actuator for generating driving force to cause the rocking displacement of the cam member and a press member for pressing the drive portion of the cam member in a direction to cause the rocking displacement of the cam member by the driving force output from the actuator.

[0013] Further, in the present invention, said cam system is configured that both sides are symmetric with respect to a centerline so as to perform the same action even when a carriage, to which the cam system is mounted, runs back and forth, and said movable cam mechanism includes

a pair of said actuator and said press member arranged near the centerline, and

a pair of said cam members arranged at both sides of the centerline such that said drive portion is located

ed at a position close to the centerline and said control portion is located at a position far from the centerline ,
so that both of the drive portions of the pair of cam members are controlled in common by the pair of the actuator and press member.

[0014] The present invention further provides a method for controlling a slider of a flatbed knitting machine, the flatbed knitting machine having at least a pair of needle beds opposed to each other with respect to a needle bed gap, and needle grooves arranged side by side in a line in each needle bed, and compound needles, each of which being provided in each needle groove and formed by combining a needle body having a hook at a head end thereof, and a slider making slide movement with respect to the needle body and having a tongue at a head end thereof, the tongue opening and closing the hook, so that a needle driving butt of the needle body and a slider driving butt of the slider are driven by a cam system so as to catch a knitting yarn in the hook when the hook is advanced into a needle bed gap and then withdrawn into the needle bed, characterized in that

providing a cam in a section corresponding to a part within a trajectory of a knitting route through which the slider driving butt passes in a knit operation, when catching the knitting yarn in the hook, and controlling a position of the slider by acting on the slider driving butt into a high position in a direction to be advanced into the needle bed gap for making an old stitch retained in the tongue hardly to drop into the hook, or a low position in a direction to be withdrawn from the needle bed gap for making the knitting yarn fed from a yarn feeder hardly to get caught on the tongue.

[0015] Further, in the present invention, said change by the control of the slider position carried out, depending on a needle selection state in such a manner that the action on the slider driving butt through said cam, is varied depending on as to whether or not a position, at which the knitting yarn extending from the yarn feeder to a knitted fabric, is closer to the needle bed, in which the compound needle which catches the knitting yarn is provided, than an intermediate position of the needle bed gap to thereby change the position of the slider into the low position or the high position.

[Advantageous Effects of Invention]

[0016] According to the present invention, the movable cam mechanism can control the position of the slider at which an old stitch is retained on the tongue when catching a knitting yarn by the hook so as to be changed between a high position in a direction to be advanced into the needle bed gap for making the old stitch hardly to drop into the hook and a low position in a direction to be withdrawn from the needle bed gap for making the knitting yarn hardly to get caught on the tongue. Therefore, when

forming stitches, it becomes possible to make the old stitch hardly to drop into the hook from the tongue and also make a knitting yarn which is to be caught in the hook in order to form a new stitch hardly to get caught on the tongue depending on the structure of a fabric to be knitted.

[0017] Further, according to the present invention, it is possible to simplify the structure of the movable cam mechanism because it is only necessary to switch the position of the slider just into two stages.

[0018] Further, according to the present invention, providing the lever-shaped cam member, the actuator and the pressing member in a portion of the cam system, the portion acting on the slider driving butt, makes it possible to control the position of the slider when catching the knitting yarn in the hook.

[0019] Further, according to the present invention, the cam system which includes the movable cam mechanism is formed so as to be symmetric with respect to the centerline thereof so that the cam system can perform the same action even when the carriage on which the cam system is mounted runs back and forth. Since the actuator and the pressing member are arranged near the centerline, it is possible to drive both of the cam members at both sides of the cam system at the same time by the actuator and the pressing member working as a pair to thereby control the position of the slider in the same manner regardless of the running direction of the carriage.

[0020] Further, according to the present invention, when knitting a fabric, it is possible to control the position of the slider so that the position is changed by the action of the cam on the slider driving butt, between one case in which a needle bed at one side of the needle bed gap is used and the other case in which needle beds at both sides thereof are used, depending on the structure of the fabric, and to continue the knitting of the fabric reliably.

[0021] Further, according to the present invention, it is possible to perform control to change the position of the slider by varying the action on the slider driving butt through the cam in response to a needle selection state.

[Brief Description of Drawings]

[0022]

[Fig. 1] Figs. 1 are a side view showing a structure of a main part of a compound needle 11, and a cam layout view showing a structure of a main part of a cam system 30, which is used in a flatbed knitting machine 21 as an embodiment of the present invention.

[Fig. 2] Figs. 2 are partial cam layout views each showing an operation of a movable cam mechanism 40 of Figs. 1.

[Fig. 3] Figs. 3 are simplified side views each showing the operation of the flatbed knitting machine 21 of Figs. 1.

[Fig. 4] Fig. 4 is a side view showing a schematic

structure of the movable cam mechanism 40 of Figs. 1.

[Fig. 5] Figs. 5 are plane views, front views and right side views showing a structure of a pressing member 42 and a cam member 41 which are provided in the movable cam mechanism 40 of Figs. 1.

[Fig. 6] Figs. 6 show are a plan view, a front view, a cross-sectional view seen according to a cutting surface line C-C and a right side view, showing a structure of a slider cam 36 in which the movable cam mechanism 40 of Figs. 1 is provided.

[Fig. 7] Figs. 7 are simplified side views each showing an operation of a compound needle 11 in a conventional flatbed knitting machine 1.

[Description of Embodiments]

[0023] Hereinafter, a structure and an operation of a flatbed knitting machine 21 as an embodiment of the present invention will be described using Figs. 1 to 6, thereby elements corresponding to those in Figs. 7 will be denoted by the same reference signs and the overlapped explanation will be omitted. Further, in a description of each figure, the description may be made using a sign which is not shown in the figure being described, but shown in the figure which has already been described.

[Examples]

[0024] Fig. 1(a) shows a structure of a main part of a compound needle 11. A needle driving butt 22 and a slider driving butt 23 are respectively provided on a needle body 12 and a slider 13 of the compound needle 11. In this regard, the needle driving butt 22 is provided on a needle jack 24 which is coupled to a tail portion of the needle body 12. The needle driving butt 22 and the slider driving butt 23 are provided at a tail portion side of the compound needle 11, and controlled as to whether or not they are protruded from a surface of a needle groove by the action of a needle selection member, which is omitted to be drawn.

[0025] Fig. 1(b) shows a structure of a main part of a cam system 30 which is mounted to a carriage used in a flatbed knitting machine 21 as an example of the present invention. The cam system 30 is placed on a base plate 31 of the carriage, the base plate 31 facing needle beds 3, 4. The cam system 30 includes a needle raising cam 32, a center cam 33, stitch cams 34, 35, a slider cam 36, and the like. The cam system 30 is arranged to be in a line symmetry state with respect to a centerline 30c so that the action on the needle driving butt 22 and the slider driving butt 23 can be equally performed when the carriage runs from side to side. In this regard, each stitch cams 34, 35 is controlled so that a position thereof is changed by sliding along an inclined guide path depending on a running direction of the carriage. A leading side of the stitch cams 34, 35 retreats

toward the slider cam 36 side. A following side of the stitch cams 34, 35 moves toward the needle raising cam 32 side depending on a stitch density value which indicates the size of a stitch loop formed as a new stitch.

[0026] For example, when the carriage runs in a direction to move the cam system 30 to the left side of the figure, the needle driving butt 22 is guided along a trajectory 22t in a needle guide path 37 which is formed between the needle raising cam 32, and the center cam 33 and the stitch cams 34, 35. The slider driving butt 23 is guided along a trajectory 23t in a slider guide path 38 which is provided in the slider cam 36.

[0027] A yarn feeder 7 runs in synchronization with the carriage so that the phase of a centerline 7c of a yarn feeder port 7a is maintained to be away from the centerline 30c of the cam system 30 toward the following side. The slider 13 is prevented from approaching the needle bed gap 2 along with the needle body 12 by a restriction of the slider guide path 38 and waits inside the needle bed 3, 4 up to the vicinity of the centerline 30c of the cam system 30. When the needle driving butt 22 is moved along the trajectory 22t and the hook 12a is thereby advanced into the needle bed gap 2, a tongue 13a opens a hook mouth of the hook 12a, so that an old stitch, which has been formed and retained in the hook 12a in a previous knitting course, is transferred onto the tongue 13a and cleared from the hook 12a. The hook 12a is located at the most advanced position with respect to the needle bed gap 2 at the centerline 30c and then withdrawn toward the needle bed 3, 4. At a following side from the centerline 30c, a knitting yarn is fed from the yarn feeder port 7a on the phase of the centerline 7c of the yarn feeder 7 so as to pass within a range through which the hook mouth of the hook 12a passes.

[0028] In the present example, a movable cam mechanism 40 is provided in the slider cam 36. The movable cam mechanism 40 includes cam members 41 each of which carries out an operation for switching a part of the trajectory 23t in a section of the slider guide path 38 of the slider cam 36, and the section corresponds to the phase in the vicinity of the centerline 7c of the yarn feeder 7. The cam member 41 has a control portion 41a at one end thereof, for controlling the position of the slider 13, in such a manner that the cam member 41 switches action or inaction for the control portion 41a of the slider driving butt 23 by rocking displacement of the cam member 41 so as to change the position of the slider driving butt 23, thereby producing a difference d in the position of the slider 13. The rocking displacement of the cam member 41 is caused by a press of a pressing member 42 against a drive portion 41b provided at the other end of the cam member 41.

[0029] Figs. 2 show an operation of the movable cam mechanism 40 of Figs. 1. The cam member 41 is changed over so that the control portion 41a does not act on the slider driving butt 23 which passes through the trajectory 23t as shown in Fig. 2(a), but the control portion 41a acts on the slider driving butt 23 shown in Fig. 2(b). The cam

member 41 has a lever shape, and a drive portion 41b is provided at the other end thereof. A put-in concave portion 36a for putting in the cam members 41 is provided on a back surface of the slider cam 36, the back surface being an opposite surface with respect to a surface which faces the needle beds 3, 4. In the put-in concave portion 36a of the slider cam 36, bosses 36b are provided in a standing manner, each of the bosses 36b supports the cam member 41 at an intermediate position between the control portion 41a and the drive portion 41b so that the cam member 41 is supported so as to be capable of rocking displacement about a support axis line 41c. A press member 42 and a torque spring 43 act on the cam member 41. In this regard, a part of the cam member 41 being put in the put-in concave portion 36a, and the torque spring 43 inside the put-in concave portion 36a, are indicated by solid lines in Figs. 2 for convenience sake. These are actually located inside the slider cam 36, and corresponding parts thereof in other figures are therefore drawn with dotted lines.

[0030] The torque spring 43 biases the cam member 41 in a direction in which the control portion 41a does not act on the slider driving butt 23 as shown in Fig. 2(a). The press member 42 is provided with a pressing inclined surface 42a which goes up and down. A head end of the pressing inclined surface 42a at the near side of the figure is inclined downward, in a going down state shown in Fig. 2(a), the pressing inclined surface 42a comes into contact with the drive portion 41b of the cam member 41 near the head end thereof. When the pressing inclined surface 42a is made going up toward the front side of the sheet of the figure, as shown in Fig. 2(b), the contact portion of the drive portion 41b with respect to the press member 42 is moved over the pressing inclined surface 42a and transferred to a pressing flat surface 42b which is a top surface of the press member 42. This transfer of the contact portion leads to rocking displacement of the cam member 41 in the clockwise direction against the biasing action of the torque spring 43, so that the control portion 41a is brought to act on the slider driving butt 23.

[0031] It is also possible to control the position of the slider driving butt 23 by switching the action or inaction not by means of such rocking displacement of the control portion 41a, but by means of slide as being performed by the stitch cams 34, 35 or a going up and down operation as being performed by the press member 42. Further, when the position of the slider driving butt 23 is controlled by the rocking displacement or the slide, it is also possible that the slider driving butt 23 be subjected to actions in any case so that the control of the position of the slider driving butt 23 can be performed by a difference of positions thereof. Further, even when a cam that acts on the slider driving butt 23 is fixed, it is also possible to control the position of the slider driving butt 23 by performing control to switch the protrusion height of the slider driving butt 23 from a needle groove 5 toward the cam to thereby switch action or inaction by the cam on the slider driving butt 23. Furthermore, providing the cam with

acting portions having different heights also makes it possible to introduce the slider driving butt 23 into different routes according to the difference of the protrusion height of the slider driving butt 23.

[0032] Figs. 3 show effect caused by performing the switching as shown in Figs. 2. As shown in Fig. 3(a), a waiting position of the slider 13 can be switched so as to have the difference d in terms of a distance to the needle bed gap 2. Therefore, when knitting a plain knit fabric 9 shown in Fig. 7(a) and the like, a head end position of the tongue 13a is switched to a low position in a direction to be withdrawn from the needle bed gap 2. On the other hand, when knitting a rib knit fabric 10 and the like as shown in Fig. 3(b), the head end position of the tongue 13a is switched to a high position in a direction to be advanced into the needle bed gap 2. At the high position, since the head end position of the tongue 13a gets close to the needle bed gap 2, there is enough distance between a retained position of an old stitch 10a which has once been cleared and the head end position of the tongue 13a. Accordingly, the old stitch 10a is hardly to drop into the hook 12a.

[0033] Performing such a switching operation appropriately makes it possible to reliably form stitches, when knitting the plain knit fabric 9, the rib knit fabric 10 and the like, depending on the structure of the fabric even in end portions of the fabric, or end portions of an intarsia section or a portion in which stitch is formed by using a kick back within a knitting width of the fabric. Since the flatbed knitting machine 21 is controlled by a program of a computer which is mounted thereto, it is also possible to automatically carry out the switching. For example, it is possible to determine as to whether the needle bed 3 at one side of the needle bed gap 2 is used or the needle beds 3, 4 at both sides thereof are used based on a needle selection state. Further, it is also possible to previously set a program, in the flatbed knitting machine 21 or a design device, to automatically determine such a needle selection state from needle selection data and control the slider driving butt 23 through the movable cam mechanism 40 so as to change the position of the tongue 13a. When the tongue 13a is located at a high position, the old stitch 9a or 10a is reliably retained in the tongue 13a. On the other hand, when the tongue 13a is located at a low position, it is possible to make the knitting yarn 8 hardly to get caught on the tongue 13a when the knitting yarn 8 is passed into a position to be caught in the hook mouth of the hook 12a.

[0034] Fig. 4 is a side view showing a schematic structure of the movable cam mechanism 40. As shown in Fig. 1(b), in the cam members 41 at both sides of the centerline 30c, the pressing inclined surface 42a or the pressing flat surface 42b of the press member 42 acts simultaneously on both of the drive portions 41b which are closely arranged to each other. As shown in Fig. 4, in the press member 42, a shaft portion 42d having an axis line 42c at the center thereof is inserted into a support block 44a. When an actuator 44 such as a solenoid which is provided

at a base end side of the press member 42 operates so as to be along the axis line 42c, the pressing inclined surface 42a and the pressing flat surface 42b both provided at the head end of the press member 42 are driven so as to go up and down from the surface of the base plate 31. When both of the pressing inclined surface 42a and the pressing flat surface 42b go up from the base plate 31 as shown in the figure, as shown in Fig. 2(b), the drive portion 41b of the cam member 41 is pushed upward of the figure to thereby cause rocking displacement of the cam member 41, and the control portion 41a is thereby displaced downward. In addition, the press member 42 is biased in a direction in which the pressing flat surface 42b sinks below the base plate 31 by a compression spring 45 which is inserted between the support block 44a and the actuator 44.

[0035] Although the position of the tongue 13a is switched into two stages in the movable cam mechanism 40 of the present embodiment, the position of the tongue 13a may also be changed into a plurality of stages or changed steplessly by the use of an air cylinder or a motor as the actuator 44. The position of the tongue 13a can be changed depending on force to move the fabric downward, a tightened state of knitted stitches, and the like.

[0036] Figs. 5 show a structure of the press member 42 and the cam member 41, which are provided in the movable cam mechanism 40, with Fig. 5(a) and Fig. 5(b) respectively, wherein the figures include a plane view, a front view and a right side view. The cam members 41, which makes rocking displacement by the action of the pressing inclined surface 42a or the pressing flat surface 42b of the press member 42, includes a boss insertion hole 41d whose centerline is the support axis line 41c between the control portion 41a and the drive portion 41b. The boss 36b of the slider cam 36 is inserted into the boss insertion hole 41d so that the cam member 41 is supported so as to be capable of rocking displacement.

[0037] Figs. 6 show a structure of the slider cam 36 in which the movable cam mechanism 40 is provided, wherein Fig. 6(a) shows a plane view, Fig. 6(b) shows a front view, Fig. 6(c) shows a cross-sectional view seen according to a cutting surface line C-C of Fig. 6(a), and Fig. 6(d) shows a right side view thereof, respectively. As shown in Fig. 6(a), the put-in concave portion 36a, which puts in the right and left cam members 41, is provided in the slider cam 36. A press member insertion hole 36d, into which a going up and down portion of the press member 42 including the pressing inclined surface 42a and the pressing flat surface 42b is inserted, is provided near the center of the put-in concave portion 36a. Further, opening portions 36e which come through the slider guide path 38 are provided in both lower end portions of the put-in concave portion 36a. The control portion 41a of the cam member 41 goes up into the slider guide path 38 through the opening portion 36e, thereby enabling the control portion 41a to act on the slider driving butt 23.

[Reference Signs List]

[0038]

5	2	Needle bed gap
	3,4	Needle bed
	7	Yarn feeder
	7a	Yarn feeder port
	8	Knitting yarn
10	9	Plain knit fabric
	9a,10a	Old stitch
	10	Rib knit fabric
	11	Compound needle
	12	Needle body
15	12a	Hook
	13	Slider
	13a	Tongue
	21	Flatbed knitting machine
	22	Needle driving butt
20	23	Slider driving butt
	30	Cam system
	36	Slider cam
	38	Slider guide path
	40	Movable cam mechanism
25	41	Cam member
	41a	Control portion
	41b	Drive portion
	42	Press member
	42a	Pressing inclined surface
30	42b	Pressing flat surface
	44	Actuator

Claims

- 35 1. A flatbed knitting machine (21) provided with compound needles (11), each compound needle (11) being formed by combining a needle body (12) and a slider (13), the needle body (12) having a hook (12a) at a head end thereof, and the slider (13) making slide movement with respect to the needle body (12) and having a tongue (13a) at a head end thereof, the tongue (13a) opening and closing the hook (12a), so that a needle driving butt (22) of the needle body (12) and a slider driving butt (23) of the slider (13) are driven by a cam system (30) so as to catch a knitting yarn (8) in the hook (12a) when the hook (12a) is advanced into a needle bed gap (2) and then withdrawn into the needle bed (3,4),

characterized in that

the flatbed knitting machine (21) includes

a movable cam mechanism (40), which fronts a section corresponding to a trajectory (23t) of a knitting route through which the slider driving butt (23) passes in a knit operation when catching the knitting yarn (8) in the hook (12a), and being capable of controlling a position of the slid-

- er (13) by acting on the slider driving butt (23) into a high position in a direction to be advanced into the needle bed gap (2) for making an old stitch (9a,10a) retained on the tongue (13a) hardly to drop into the hook (12a), or a low position in a direction to be withdrawn from the needle bed gap (2) for making the knitting yarn (8) fed from a yarn feeder (7) hardly to get caught on the tongue (13a).
2. The flatbed knitting machine (21) provided with compound needles (11) according to claim 1, wherein said movable cam mechanism (40) includes a cam member (41) capable of switching the position of said slider (13) into two stages by controlling action or inaction on said slider driving butt (23), in said section corresponding when the slider driving butt (23) being positioned to catch the knitting yarn (8) in said hook (12a).
 3. The flatbed knitting machine (21) provided with compound needles (11) according to claim 2, wherein said cam member (41) has a lever shape, and is provided with a control portion (41a) for performing control on said slider driving butt (23) at one end thereof and a drive portion (41b) to receive driving for the control at the other end thereof, being supported at an intermediate position between the control portion (41a) and the drive portion (41b) so as to be capable of rocking displacement, and the movable cam mechanism (40) includes an actuator (44) for generating driving force to cause the rocking displacement of the cam member (41) and a press member (42) for pressing the drive portion (41b) of the cam member (41) in a direction to cause the rocking displacement of the cam member (41) by the driving force output from the actuator (44).
 4. The flatbed knitting machine (21) provided with compound needles (11) according to claim 3, wherein said cam system (30) is configured that both sides are symmetric with respect to a centerline (30c) so as to perform the same action even when a carriage, to which the cam system (30) is mounted, runs back and forth, and said movable cam mechanism (40) includes

a pair of said actuator (44) and said press member (42) arranged near the centerline (30c), and a pair of said cam members (41) arranged at both sides of the centerline (30c) such that said drive portion (41b) is located at a position close to the centerline (30c) and said control portion (41a) is located at a position far from the centerline (30c),

so that both of the drive portions (41b) of the pair of cam members (41) are controlled in common by the pair of the actuator (44) and press mem-

ber (42).

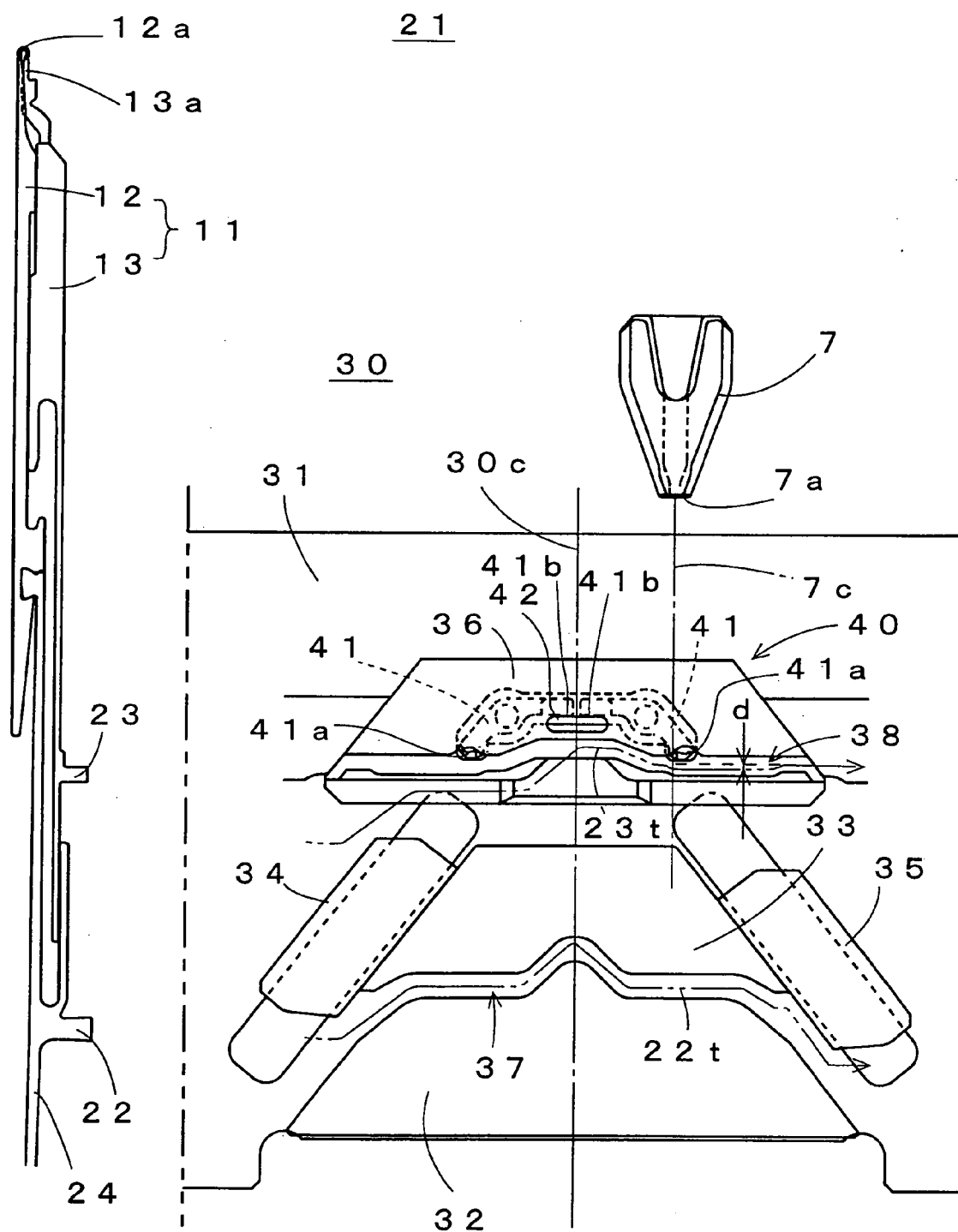
5. A method for controlling a slider (13) of a flatbed knitting machine (21), the flatbed knitting machine (21) having at least a pair of needle beds (3,4) opposed to each other with respect to a needle bed gap (2), and needle grooves (5) arranged side by side in a line in each needle bed (3,4), and compound needles (11), each of which being provided in each needle groove (5) and formed by combining a needle body (12) having a hook (12a) at a head end thereof, and a slider (13) making slide movement with respect to the needle body (12) and having a tongue (13a) at a head end thereof, the tongue (13a) opening and closing the hook (12a), so that a needle driving butt (22) of the needle body (12) and a slider driving butt (23) of the slider (13) are driven by a cam system (30) so as to catch a knitting yarn (8) in the hook (12a) when the hook (12a) is advanced into a needle bed gap (2) and then withdrawn into the needle bed (3,4),

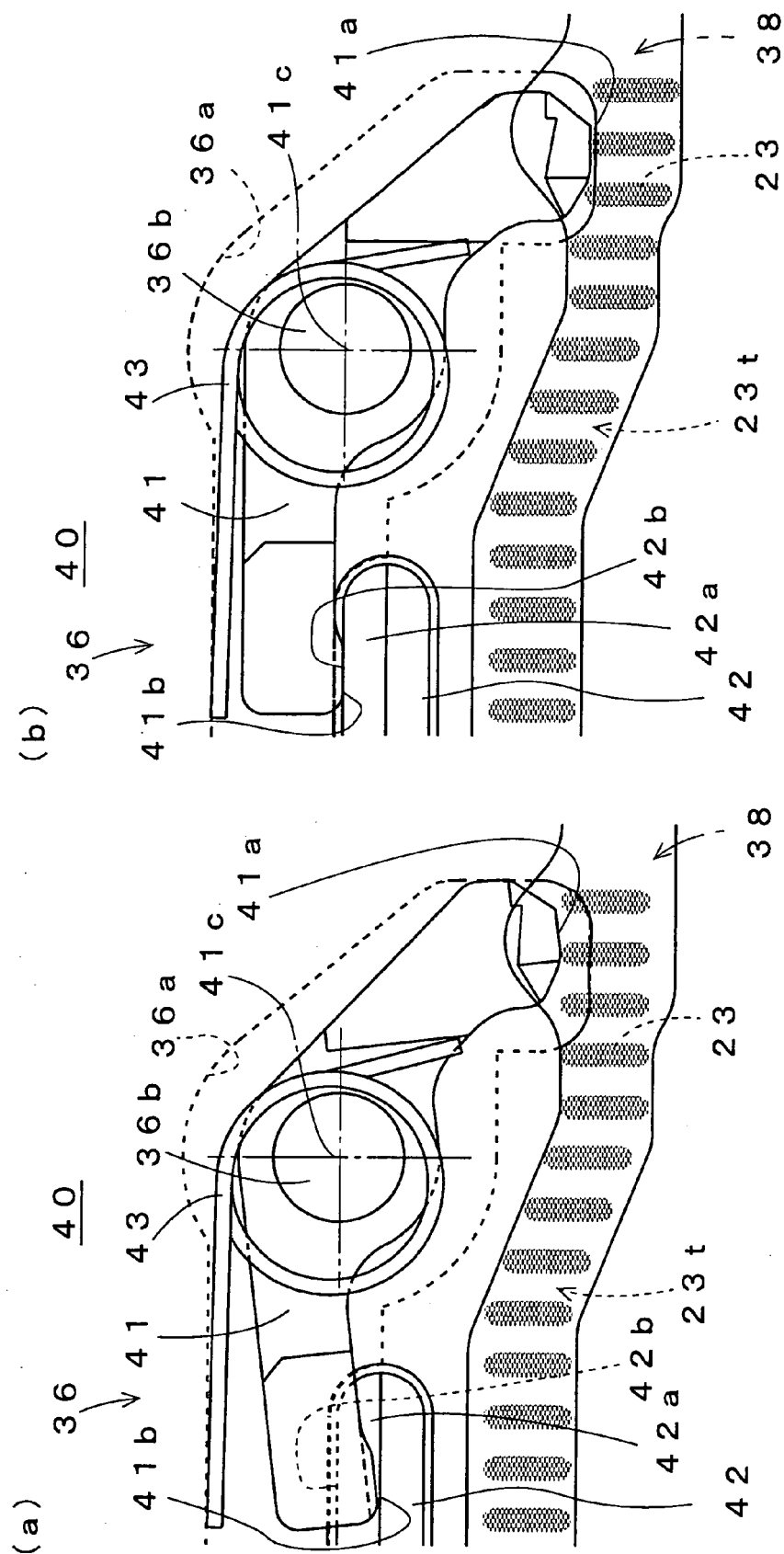
characterized in that

providing a cam (41) in a section corresponding to a part within a trajectory (23t) of a knitting route through which the slider driving butt (23) passes in a knit operation, when catching the knitting yarn (8) in the hook (12a), and controlling a position of the slider (13) by acting on the slider driving butt (23) into a high position in a direction to be advanced into the needle bed gap (2) for making an old stitch (9a,10a) retained on the tongue (13a) hardly to drop into the hook (12a), or a low position in a direction to be withdrawn from the needle bed gap (2) for making the knitting yarn (8) fed from a yarn feeder (7) hardly to get caught on the tongue (13a).

6. The method for controlling a slider (13) of a flatbed knitting machine (21) according to claim 5, wherein said change by the control of the slider (13) position carried out, depending on a needle selection state in such a manner that the action on the slider driving butt (23) through said cam (41), is varied depending on as to whether or not a position, at which the knitting yarn (8) extending from the yarn feeder (7) to a knitted fabric (9,10), is closer to the needle bed (3,4), in which the compound needle (11) which catches the knitting yarn (8) is provided, than an intermediate position of the needle bed gap (2) to thereby change the position of the slider (13) into the low position or the high position.

(a) (b) Fig.1





File 2

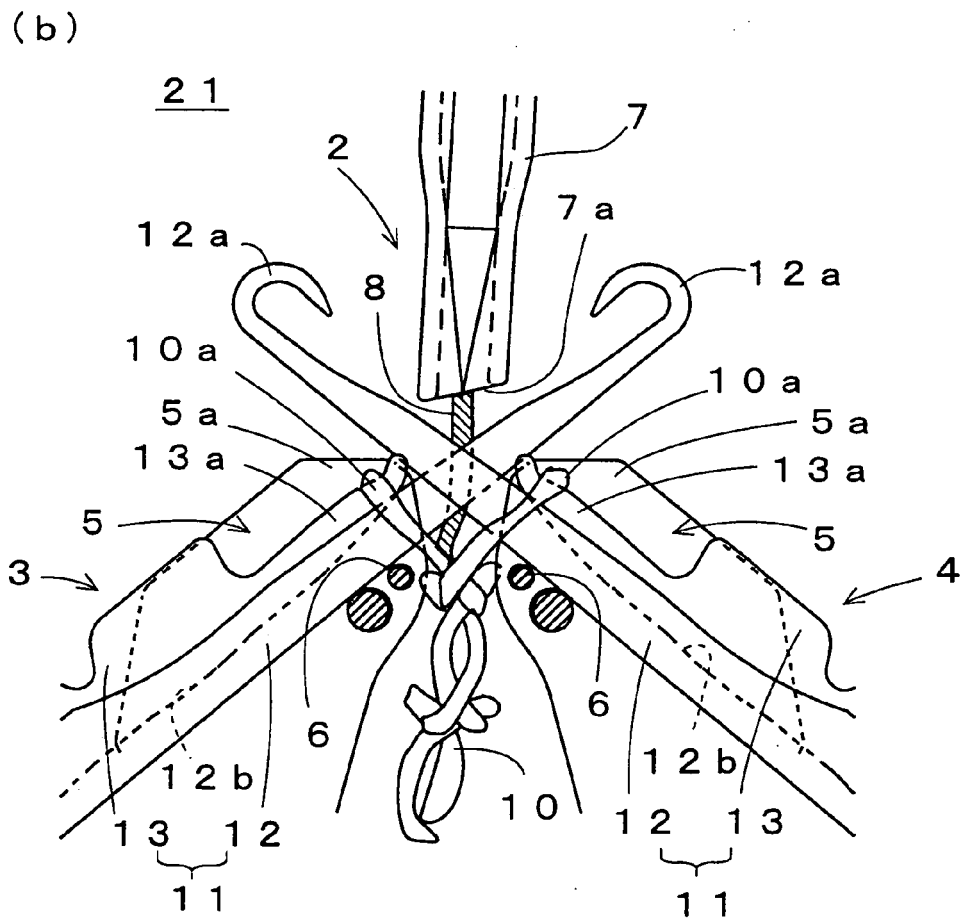
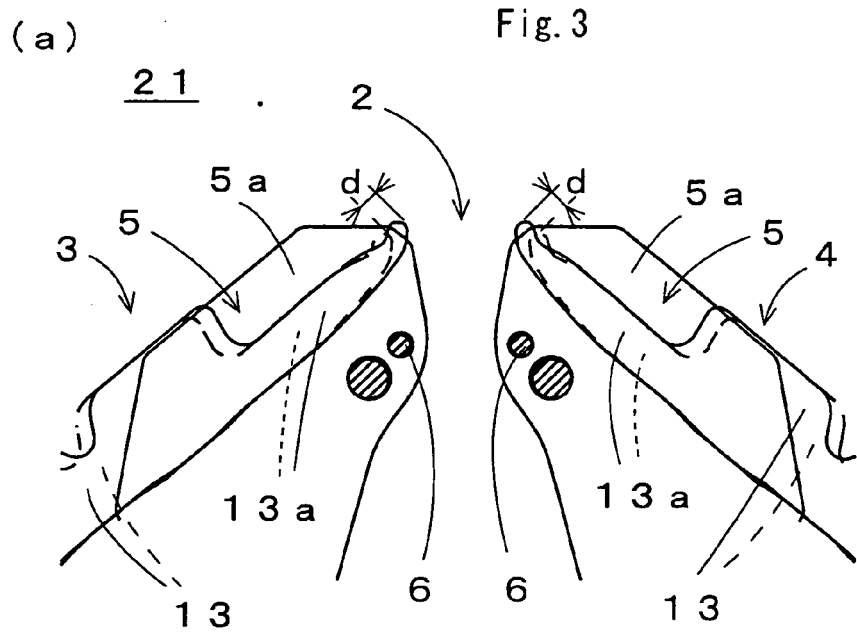
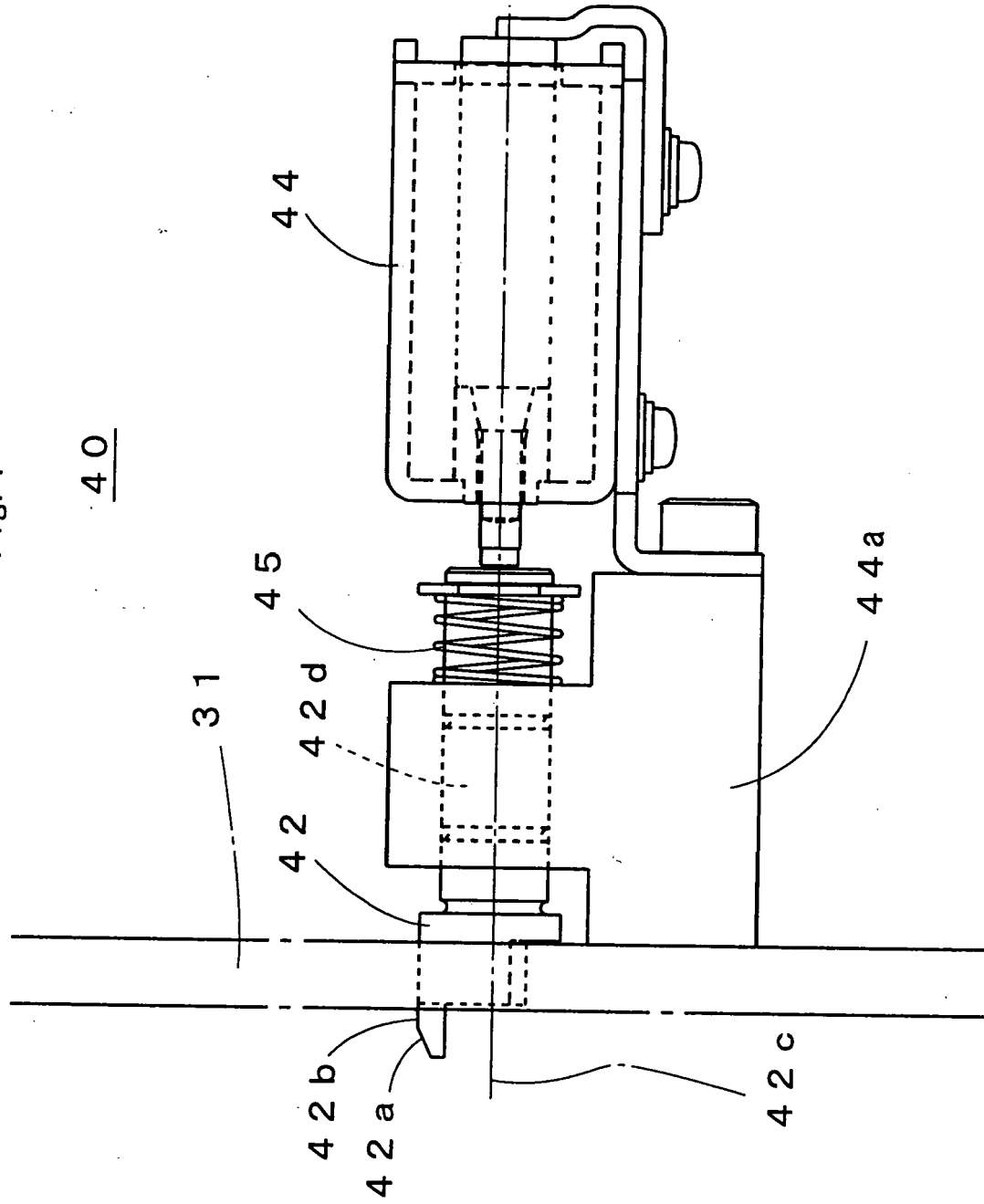
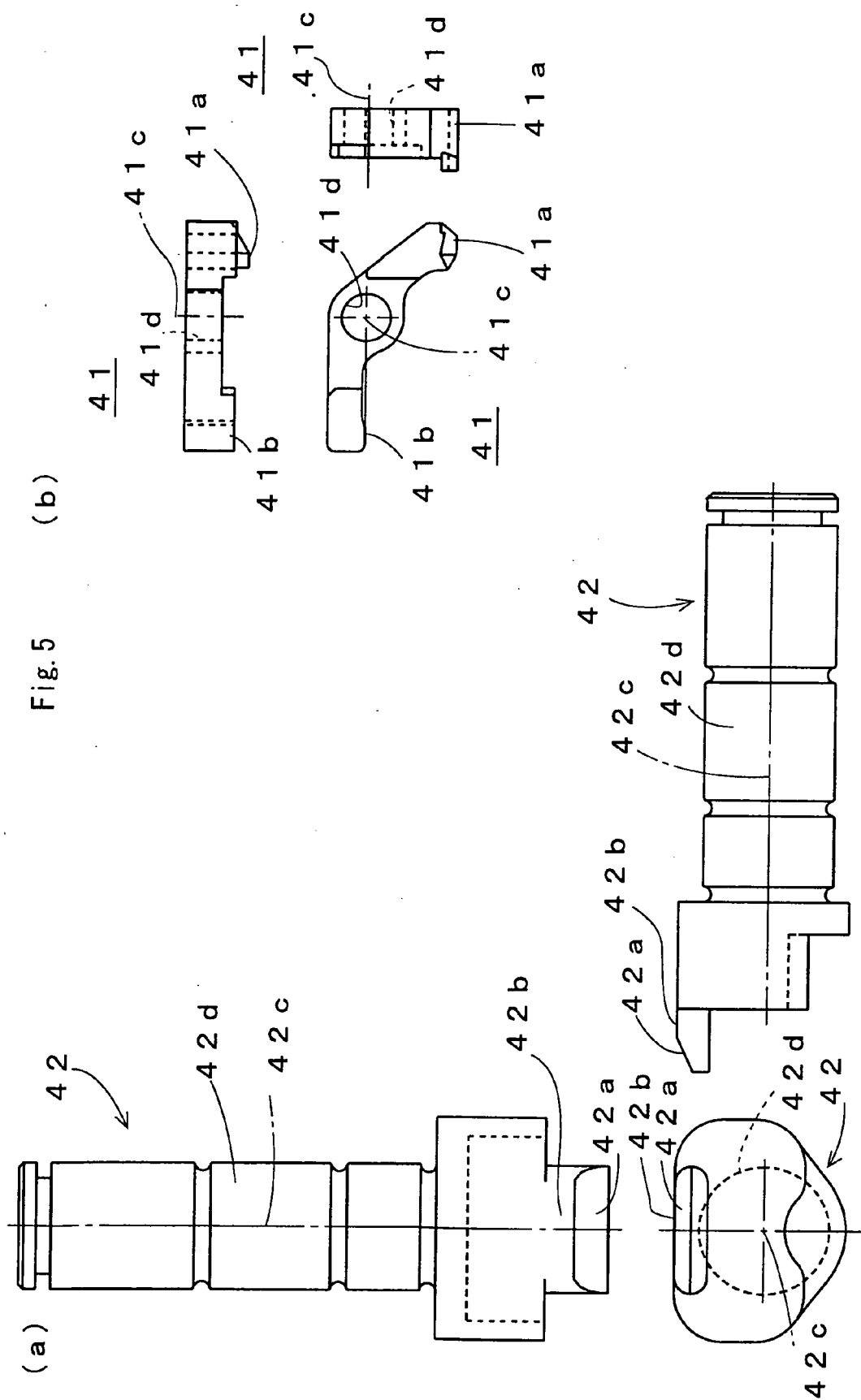
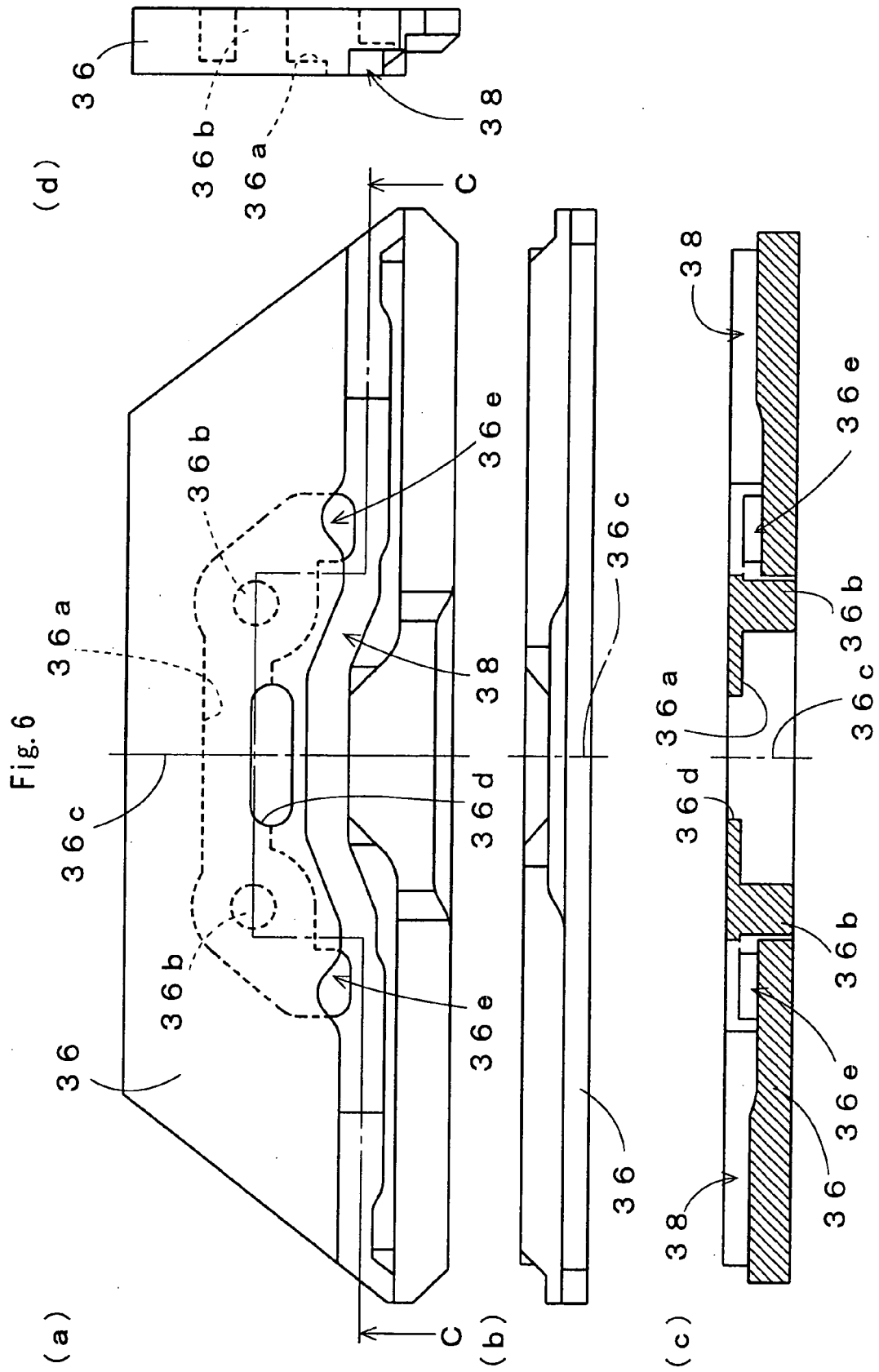


Fig. 4

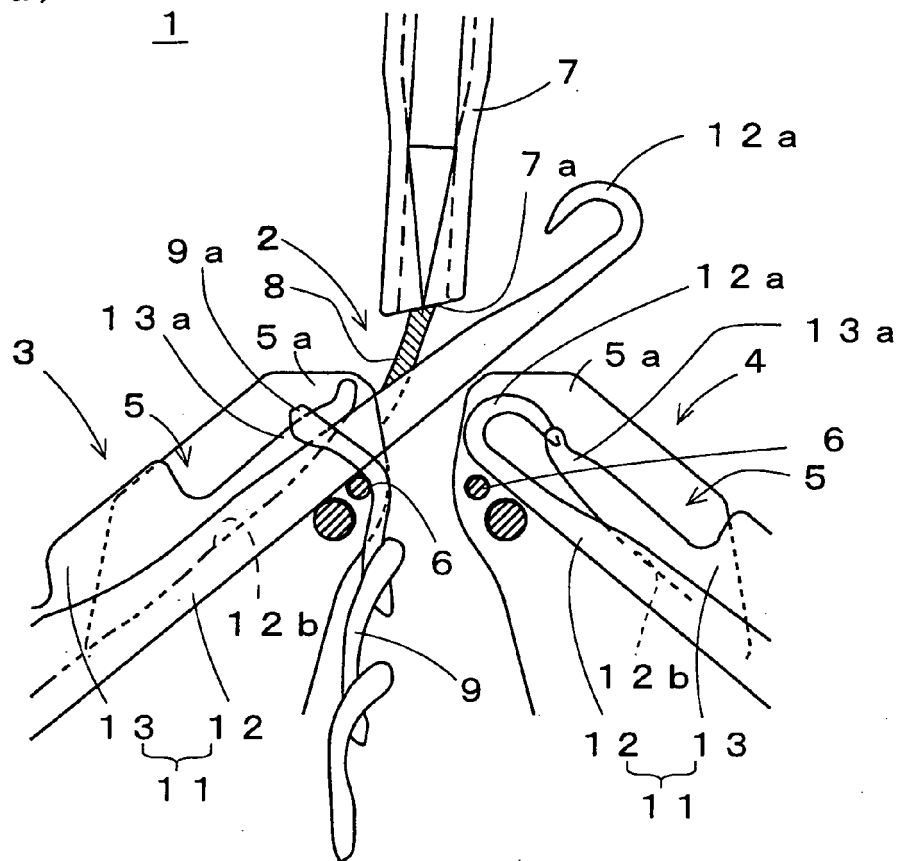




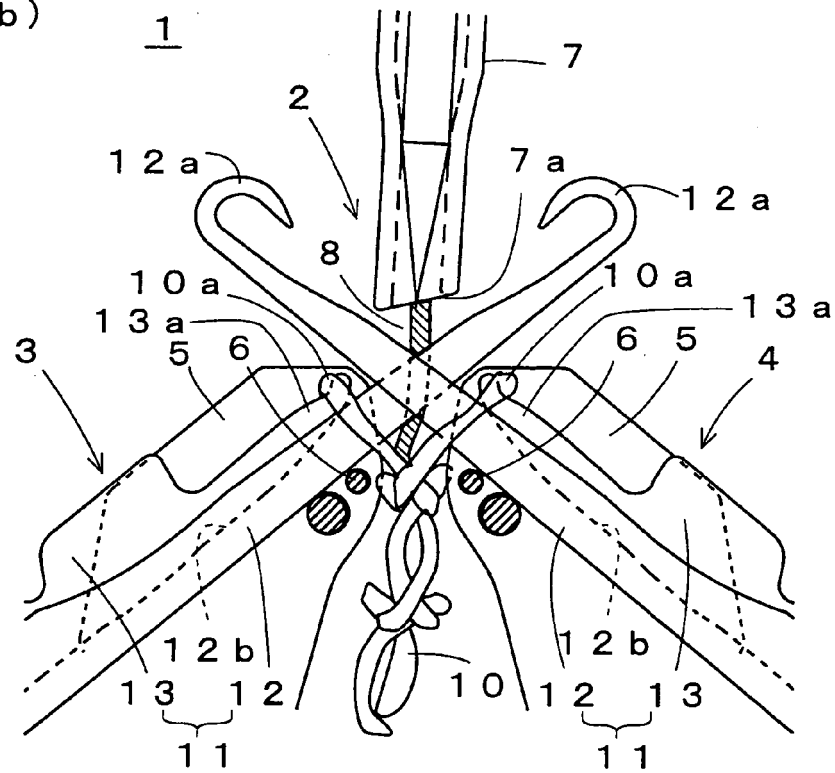


(a)

Fig. 7



(b)





EUROPEAN SEARCH REPORT

Application Number
EP 12 00 6424

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Place of search Munich		Date of completion of the search 22 October 2012	Examiner Wendl, Helen
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