



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
24.09.2008 Bulletin 2008/39

(51) Int Cl.:
D04B 7/14 (2006.01) D04B 15/56 (2006.01)

(21) Application number: **06832769.1**

(86) International application number:
PCT/JP2006/322889

(22) Date of filing: **16.11.2006**

(87) International publication number:
WO 2007/058275 (24.05.2007 Gazette 2007/21)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR

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(30) Priority: **17.11.2005 JP 2005333269**

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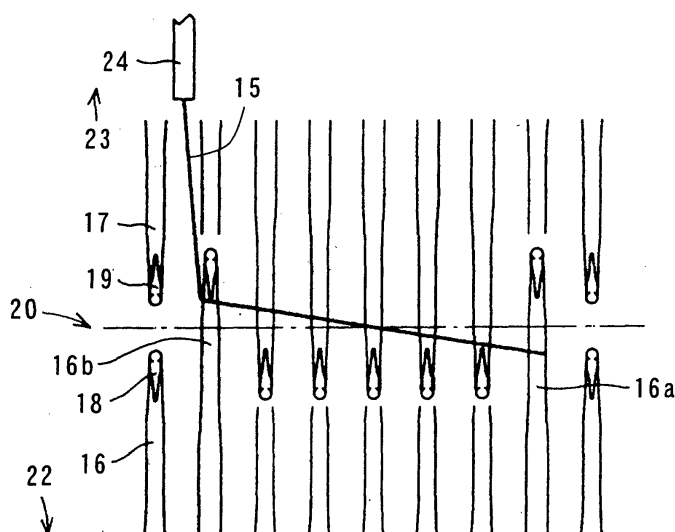
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(54) **WEFT KNITTING MACHINE CAPABLE OF INSERTING WARP AND KNITTING METHOD BY THAT WEFT KNITTING MACHINE**

(57) The invention relates a warp insertable weft knitting machine in which a knitting yarn is fed only to knitting needles on one of the needle beds, and a fabric can be knitted also with knitting needles on the other of the needle beds, without using a special yarn guide apparatus or the like, using a warp, and a knitting method in the weft knitting machine. When hooks (19) of five knitting needles (17) are advanced from a back needle bed (23) between knitting needles (16a, 16b) on a front needle

bed (22), it is possible to knit back stitches with these five knitting needles (17). The number of knitting needle (16a) and the number of knitting needle (16b) may not limited to one, respectively. The knitting needles (16) from the front needle bed (22) can be advanced to an area in which the knitting needles (17) have been advanced from the back needle bed (23), and thus rib, links, or other structures with the knitting needles (16, 17) from the front and back needle beds can be knitted using a knitting yarn fed as a warp.

FIG. 1



Description

Technical Field

[0001] The present invention relates to a warp insertable weft knitting machine having not only a function to perform basic knitting of a fabric with a weft as a knitting yarn, but also a function to perform knitting of a fabric with a knitting yarn that can act as a warp, fed from a lace bar, and a knitting method in the weft knitting machine.

Background Art

[0002] It is conventionally known that a weft knitting machine 1 as shown in Fig. 10 is capable of knitting a structure similar to a warp knitting structure (see Japanese Examined Patent Publication JP-B2 3452639, for example). In the weft knitting machine 1, a pair of needle beds, a front needle bed 2 and a back needle bed 3, are opposed to each other at a needle bed gap 4. A warp insertion mechanism 5 is provided above the needle bed gap 4. A plurality of knitting needles 6 and 7 are arranged side by side respectively on the front needle bed 2 and the back needle bed 3. The warp insertion mechanism 5 can feed a knitting yarn that can act as a warp to a hook at a leading end of the knitting needle 6 which is advanced from the front needle bed 2 to the needle bed gap 4. Carriages 8 and 9 on which a cam mechanism is mounted are arranged on the front needle bed 2 and the back needle bed 3 so as to be capable of traveling back and forth in a direction perpendicular to a plane of paper. The cam mechanism is for selectively driving a plurality of knitting needles 6 and 7 back and forth with respect to the needle bed gap 4. Yarn feeders 10 are supported by yarn guide rails 11 above the needle bed gap 4 so as to be capable of traveling back and forth in a direction perpendicular to the plane of paper. A plurality of yarn guide rails 11 (for example, three yarn guide rails 11, in Fig. 10) extend above the needle bed gap 4 in a direction perpendicular to the plane of paper. Tracks on which the yarn feeders 10 travel are located on both sides of the yarn guide rails 11. The carriages 8 and 9 can selectively bring any one of the yarn feeders 10. The yarn feeders 10 feed a knitting yarn to the knitting needles 6 and 7 which are advanced to the needle bed gap 4. The weft knitting machine 1 can obtain a knitted fabric of a basic weft knitting structure by causing the carriages 8 and 9 to bring the yarn feeders 10 and causing the cam mechanism to drive the knitting needles 6 and 7.

[0003] The warp insertion mechanism 5 can perform a swing motion about a swing shaft 12 and a reciprocating motion along the swing shaft 12. The warp insertion mechanism 5 includes a plurality of lace bars 13. A plurality of yarn feeding tubes 14 can be attached to each of the lace bars 13. Each of the yarn feeding tubes 14 can feed a knitting yarn to a hook at the leading end of the knitting needle 6 which is advanced from the front

needle bed 2 to the needle bed gap 4. The plurality of yarn feeding tubes 14 are spaced away from each other in a direction perpendicular to the plane of paper. Four rows of yarn feeding tubes 14 can be arranged in the warp insertion mechanism 5, as shown in Fig. 10. The swing motion of the warp insertion mechanism 5 about the swing shaft 12 causes the tip of the yarn feeding tube 14 to perform a swing operation crossing the needle bed gap 4. The reciprocating motion of the warp insertion mechanism 5 along the swing shaft 12 causes the tip of the yarn feeding tube 14 to perform a lapping operation in the longitudinal direction of the needle bed gap 4. A structure similar to a warp knitting structure can be knitted with a combination of the swing operation and the lapping operation of the yarn feeding tube 14 on the knitting needle 6. Herein, in a case where knitting yarns are fed to a plurality of knitting needles 6 with the lapping operation, a weft knitting structure is knitted with intermediate knitting needles 6. It should be noted that the swing operation and the lapping operation are performed in a state where the carriages 8 and 9 and the yarn feeders 10 have been stopped at positions away from the yarn feeding tubes 14 in a direction perpendicular to the plane of paper.

[0004] The warp insertion mechanism 5 can be used for the purpose of not only knitting a structure similar to a warp knitting structure but also knitting a weft knitting structure (see Japanese Unexamined Patent Publication JP-A 8-74146 (1996), for example). Fig. 16 in JP-A 8-74146 shows an example in which plating knitting is partially performed with a combination of knitting yarns corresponding to those fed from the yarn feeder 10 and from the yarn feeding tube 14 in Fig. 10 of the present application. Fig. 17 in JP-A 8-74146 shows an example in which a belt-like pattern with a relatively narrow width is knitted using many yarn feeding tubes 14 that can be attached at relatively narrow intervals to the lace bar 13. Fig. 1 in JP-A 8-74146 shows the arrangement of cams on a front carriage corresponding to the carriage 8 for the front needle bed 2 shown in Fig. 10 of the present application. Three cam systems are mounted on the front carriage. The middle system is a weft cam lock having functions of knitting and stitch transfer. The systems on both sides of the middle system are warp cam locks for performing knitting with a knitting yarn fed from the warp insertion mechanism 5.

[0005] With the weft knitting machine 1 as shown in Fig. 10, it is also possible to knit a weft knitting structure as described above using a knitting yarn fed from the yarn feeding tube 14 in the warp insertion mechanism 5. However, the weft knitting machine 1 is specified such that the warp insertion mechanism 5 feeds a knitting yarn only to the knitting needles 6 on the front needle bed 2, which is one of two needle beds. According to the specification of this type of weft knitting machine 1, a knitting yarn is not fed from the yarn feeding tube 14 to the knitting needles 7 on the back needle bed 3, which is the other of the needle beds, and a warp cam lock adapted for knitting using a knitting yarn fed from the yarn feeding

tube 14 is not mounted on the carriage 9. The reason for this is that a knitting yarn cannot be stably fed at all times to the hook of the knitting needle 7 which is advanced from the back needle bed 3 to the needle bed gap 4 although a knitting yarn may be able to be fed thereto from a limited number of the rows of yarn feeding tubes 14, for example, the left rows in Fig. 10 with the swing operation and the lapping operation.

[0006] A configuration is also conceivable in which a knitting yarn fed from a yarn feeding tube 14 is guided by an additional special guide apparatus, or the like, to the hook of the knitting needle 7 on the back needle bed 3. However, with this sort of guide apparatus or the like, the configuration of the weft knitting machine 1 may be complicated, and the number of the yarn feeders 10 or the yarn feeding tubes 14 that can be used may be limited.

Disclosure of Invention

[0007] It is an object of the invention to provide a warp insertable weft knitting machine in which a knitting yarn is fed only to knitting needles on one of the needle beds as in conventional apparatuses, and a fabric can be knitted also with knitting needles on the other of the needle beds, without using a special yarn guide apparatus or the like, using a knitting yarn inserted as a warp and a knitting method in the weft knitting machine.

[0008] The invention is directed to a warp insertable weft knitting machine comprising a pair of needle beds which are opposed to each other at a needle bed gap and a lace bar capable of feeding a knitting yarn that can act as a warp only to one of the needle beds, comprising:

a plurality of hook members that are arranged on the one of the needle beds and can be advanced to the needle bed gap;

advancement drive means which drives the hook members such that the hook members are advanced from the one of the needle beds to the needle bed gap, at positions on both sides of an area in which knitting is performed with knitting needles on the other of the needle beds; and

knitting drive means which drives the knitting needles such that the knitting needles are advanced from the other of the needle beds and knits a fabric using a knitting yarn that is fed from the lace bar and hooked between the hook members.

[0009] Moreover, the invention is directed to a knitting method in a warp insertable weft knitting machine comprising a pair of needle beds which are opposed to each other at a needle bed gap and a lace bar capable of feeding a knitting yarn that can act as a warp only to one of the needle beds, wherein knitting is also performed on the other of the needle beds using the knitting yarn fed from the lace bar, comprising:

advancing hook members from the one of the needle

beds at positions inside the needle bed gap on both sides of an area in which knitting is performed with knitting needles on the other of the needle beds; advancing the knitting needles from the other of the needle beds at a position in the area in which knitting is performed inside the needle bed gap; feeding a knitting yarn from the lace bar such that the knitting yarn is hooked between the hook members which are advanced from the one of the needle beds to the needle bed gap; and knitting a fabric using the hooked knitting yarn with the knitting needles which are advanced from the other of the needle beds to the needle bed gap.

[0010] Furthermore, in the invention, it is preferable that the knitting needles on the other of the needle beds are advanced to the needle bed gap, after the hook members are advanced from the one of the needle beds to the needle bed gap and the knitting yarn fed from the lace bar is hooked between the hook members.

[0011] Furthermore, in the invention, it is preferable that the knitting needles on the one of the needle beds are used as the hook members.

[0012] Furthermore, in the invention, it is preferable that a fabric using the knitting yarn hooked between the hook members is knitted also with the knitting needles on the one of the needle beds.

Brief Description of Drawings

[0013] Other and further objects, features, and advantages of the invention will be more explicit from the following detailed description taken with reference to the drawings.

[0014] Fig. 1 is a partial plan view showing a basic concept which is to make it possible to knit a fabric using a warp also with knitting needles on a back needle bed, in a weft knitting machine in which the warp can be fed only to knitting needles on a front needle bed as one embodiment of the invention.

[0015] Fig. 2 is a right side cross sectional view showing a state in which a swing operation of swinging a yarn feeding tube in Fig. 1 in a direction away from a needle bed gap has been performed to pull out the warp to a position below a path on which a knitting needle on the front needle bed is advanced and retracted with respect to the needle bed gap.

[0016] Fig. 3 is a right side cross sectional view showing a state in which a swing operation of swinging the yarn feeding tube in Fig. 1 toward a position above the needle bed gap has been performed to hook the warp from below to above around a needle shaft of the knitting needle on the front needle bed as the knitting needle is advanced to the needle bed gap.

[0017] Fig. 4 is a right side cross sectional view showing a state in which a lapping operation of moving the yarn feeding tube in Fig. 1 to a deeper side on a plane of paper and a swing operation of swinging the yarn feed-

ing tube in a direction away from the needle bed gap have been performed to hook the warp on a hook of a knitting needle and then to pull out the warp to a position above the back needle bed.

[0018] Fig. 5 is a right side cross sectional view showing a state in which hooks of the knitting needles have been advanced from the back needle bed in Fig. 1 to the needle bed gap.

[0019] Fig. 6 is a right side cross sectional view showing a state in which a swing operation of swinging all of four rows of yarn feeding tubes toward positions above the needle bed gap in the weft knitting machine in Fig. 1.

[0020] Fig. 7 is a view showing a simplified configuration of a cam mechanism that enables knitting to be performed using the warp as shown in Fig. 1 also with the knitting needles on the back needle bed.

[0021] Fig. 8 is a view showing in a simplified manner a configuration of warp cams in Fig. 7, loci of butts of knitting needles guided by the cams and a configuration of the knitting needle.

[0022] Fig. 9 is a view showing in a simplified manner the configuration of the warp cams in Fig. 7 and the loci of butts of knitting needles guided by the cams.

[0023] Fig. 10 is a right side cross sectional view showing a schematic configuration of a conventional weft knitting machine in which the warp can be inserted.

Best Mode for Carrying out the Invention

[0024] Now referring to the drawings, preferred embodiments of the invention are described below.

[0025] Fig. 1 shows a basic concept which is to make it possible to knit a fabric using a warp 15 also with knitting needles 17 on a back needle bed 23, in a weft knitting machine 21 in which the warp 15 can be fed only to knitting needles 16 on a front needle bed 22 as one embodiment of the invention. As described above, the warp 15 is not necessarily a knitting yarn used for knitting a warp knitting structure, but is referred to as a "warp" for the sake of convenience. The warp 15 is fed so as to be hooked on a needle shaft at a point closer to a trailing end than a hook 18 of one of the knitting needles 16 on the front needle bed 22. The knitting needles 16 for hooking the warp 15 on the front needle bed 22 are selected so as to be spaced away from each other. Hooks 19 of the knitting needles 17 on the back needle bed 23 are advanced between the knitting needles 16. A needle bed gap 20 to which the hooks 18 and 19 are advanced is formed as a gap where the front needle bed 22 and the back needle bed 23 are opposed to each other in the weft knitting machine 21. With the yarn feeders 10 as shown in Fig. 10, a knitting yarn can be fed to both knitting needles which are advanced from the front and back needle beds. However, the warp 15 is fed with a combination of a swing operation and a lapping operation of a yarn feeding tube 24, and thus the warp 15 cannot be stably fed to the knitting needles 17 on the back needle bed 23. The warp 15 can be stably fed from the yarn feeding tube

24 to the needle bodies of the knitting needles 16 on the front needle bed 22, and thus the warp 15 can be reliably hooked between the knitting needles 16. Furthermore, when the warp 15 is hooked in the needle bed gap 20 between the knitting needles 16 from the front needle bed 22, it is possible to form a knitting loop, by advancing the hook 19 of the knitting needle 17 from the back needle bed 23 to hook the warp 15 on the hook 19, and then pulling the knitting needle 17 into the back needle bed 23. Hereinafter, among the knitting needles 16 hooking the warp 15, a knitting needle on which the warp is initially hooked is referred to as a knitting needle 16a, and a knitting needle on which the warp is subsequently hooked which warp communicates with the yarn feeding tube 24 is referred to as a knitting needle 16b.

[0026] It is possible to form back stitches with five knitting needles 17, by advancing the hooks 19 of the five knitting needles 17 from the back needle bed 23, between the knitting needles 16a and 16b that are advanced from the front needle bed 22 to the needle bed gap 20 as shown in Fig. 1. The number of the knitting needle 16a that is advanced from the front needle bed 22 to the needle bed gap 20 is not limited to one, and the number of the knitting needle 16b that is advanced from the front needle bed 22 to the needle bed gap 20 is not limited to one. The warp 15 may be hooked between the knitting needles 16a and 16b on the front needle bed 22, at the boundary between a region in which face stitches are to be formed with a plurality of knitting needles 16 and a region in which back stitches are to be formed with a plurality of knitting needles 17. Furthermore, in Fig. 1, the knitting needles 16 from the front needle bed 22 can be advanced to an area in which the knitting needles 17 have been advanced from the back needle bed 23, and thus rib, links, or other structures with the knitting needles 16 and 17 from the front and back needle beds can be knitted using a knitting yarn fed as a warp. Herein, in the weft knitting machine 21, a cam mechanism mounted on carriages that travel along the needle beds drives the knitting needles 16 and 17 to advance and retract them. Thus, the state is not kept in which the knitting needles 16 and 17 have been advanced to the needle bed gap 20 as shown in Fig. 1. In Fig. 1, the knitting needles are driven such that the knitting needle 16a is initially advanced and retracted with respect to the needle bed gap 20, the five knitting needles 17 are subsequently advanced and retracted with sequentially shifted phases with respect to the needle bed gap 20, and then the knitting needle 16b is finally advanced and retracted with respect to the needle bed gap 20.

[0027] Figs. 2, 3, 4, and 5 show a schematic procedure in which knitting is performed using the warp 15 with the knitting needles 17 on the back needle bed 23 as shown in Fig. 1. Fig. 2 shows a state in which the swing operation of swinging the yarn feeding tube 24 in a direction away from the needle bed gap 20 has been performed to pull out the warp 15 to a position below the path on which the knitting needle 16a on the front needle bed 22 is ad-

vanced and retracted with respect to the needle bed gap 20. Fig. 3 shows a state in which the swing operation of swinging the yarn feeding tube 24 toward a position above the needle bed gap 20 has been performed to hook the warp 15 from below to above around the needle shaft of the knitting needle 16a on the front needle bed 22 as the knitting needle are advanced to the needle bed gap 20. Fig. 4 shows a state in which the lapping operation of moving the yarn feeding tube 24 to the deeper side on a plane of paper and the swing operation of swinging the yarn feeding tube 24 in a direction away from the needle bed gap 20 have been performed to hook the warp 15 on the needle shaft of the knitting needle 16b and then to pull out the warp 15 to a position above the back needle bed 23. Fig. 5 shows a state in which the hooks 19 of the knitting needles 17 have been advanced from the back needle bed 23 to the needle bed gap 20.

[0028] As shown in Fig. 10, a plurality of rows of yarn feeding tubes 24, for example, four rows can be provided. However, in Figs. 2 to 5, only one row is shown for the sake of convenience. The knitting needles 16 and 17 are latch needles. A stitch transfer blade 25 is attached to one side face of the latch needle. The hooks 18 and 19 at leading ends of the knitting needles 16 and 17 can be opened and closed with latches 26 and 27. The knitting needles 16 and 17 are accommodated in needle grooves so as to be capable of being advanced and retracted with respect to the needle bed gap 20. The needle grooves are formed between needle plates 28 and 29 that are arranged upright at a constant pitch respectively on the front needle bed 22 and the back needle bed 23. Wires 30 and 31 such as piano wires are arranged in a direction perpendicular to the plane of paper so as to pass through the vicinity of the ends of the front needle bed 22 and the back needle bed 23 that face the needle bed gap 20. The wires 30 and 31 function substantially as front edges of the front needle bed 22 and the back needle bed 23 that are located on the side of the needle bed gap 20. In the weft knitting machine 21, the wires 30 and 31 are supported by fixed sinkers 32 and 33 that are respectively attached to the front needle bed 22 and the back needle bed 23.

[0029] As the knitting needles 16 and 17, it is also possible to use compound needles in which a needle main body and a slider can be advanced and retracted independently of each other, instead of using latch needles. In a case where a compound needle is used in which a tongue at the leading end of the needle is separated into two portions as a slider to sandwich a hook of a needle main body therebetween, it is possible to perform stitch transfer and the like by advancing the slider to the needle bed gap 20. Thus, the stitch transfer blade 25 does not have to be used.

[0030] Fig. 6 shows a state in which the swing operation of swinging all of four rows of yarn feeding tubes toward positions above the needle bed gap 20. The swing operation is performed by angularly displacing a warp insertion mechanism 35 about a swing shaft 34 perpen-

dicular to the plane of paper. In Figs. 2 to 5, only one yarn feeding tube 24 is shown, but the yarn feeding tube 24 is the yarn feeding tube that is the farthest from the front needle bed 22 of the four rows of yarn feeding tubes.

The yarn feeding tube that is the closest to the front needle bed 22 of the four rows is referred to as a yarn feeding tube 36. Each of rows of yarn feeding tubes is attached to a lace bar 37. The lace bar 37 can be angularly displaced about the swing shaft 34 of the warp insertion mechanism 35. This swinging displacement is driven by a swing mechanism 38. The swing operation of the lace bar 37 driven by the swing mechanism 38 causes the swing operation in which the tip of each yarn feeding tube is swung between a position above the needle bed gap 20 and a position away from the needle bed gap 20 above the back needle bed 23. Herein, it is not possible to pull the warp 15 to a position below the knitting needles 17 as the knitting needles are advanced from the back needle bed 23 to the needle bed gap 20, even with the swing operation of the yarn feeding tube 24 to a position above the needle bed gap 20. More specifically, the states corresponding to Figs. 2 and 4 cannot be realized for the knitting needles 17 from the back needle bed 23. Thus, in this embodiment, the warp 15 has been hooked between the needle bodies of the knitting needles 16 which are advanced from the front needle bed 22 to the needle bed gap 20 as shown in Figs. 2 to 4. It should be noted that a knitting yarn acting as a weft can be fed from yarn feeders 39 to each of the knitting needles 16 and 17.

[0031] Fig. 7 shows the simplified configuration of a cam mechanism 40 that enables knitting to be performed using the warp 15 also with the knitting needles 17 on the back needle bed 23. The cam mechanism 40 is mounted separately as a carriage on the side of the front needle bed 22 and a carriage on the side of the back needle bed 23. Three cam systems are mounted on each of the carriages. The middle systems serving as knitting and stitch transfer cams 41F and 41B are mounted on the side of the front needle bed 22 and on the side of the back needle bed 23, respectively. Hereinafter, symbols "F" and "B" refer to the side of the front needle bed 22 and the side of the back needle bed 23, respectively. The knitting and stitch transfer cams 41F and 41B are formed for the purpose of enabling a knitting operation and a stitch transfer operation to be performed with a weft fed from the yarn feeders 39 in Fig. 6. Warp cams 42F and 42B; 43F and 43B are respectively provided on both sides of the knitting and stitch transfer cams 41F and 41B on the carriages. When the carriages travel to the left, the warp cams 42F and 42B are at the front, and the warp cams 43F and 43B are at the back. When the carriage travel to the right, the warp cams 43F and 43B are at the front, and the warp cams 42F and 42B are at the back.

[0032] Herein, the carriages for the front needle bed 22 and the back needle bed 23 can also bring the yarn feeders 39 along with the warp cams 42F and 42B; 43F and 43B. Thus, it is also possible to perform knitting with a weft fed from the yarn feeder 39, using the warp cams

42F and 42B; 43F and 43B. Moreover, it is possible to perform the knitting operation of knit with a first cam system S1 and to perform the stitch transfer operation with a second cam system S2, of the three cam systems.

[0033] Figs. 8 and 9 show in a simplified manner the configuration of the warp cams 43F and 43B in Fig. 7 and the loci of butts of knitting needles guided by the cams. Fig. 8 also shows the configuration of the knitting needle 16. The hook 18 and the latch 26 are arranged at the leading end of the knitting needle 16. A needle jack 45 is linked to the trailing end of the knitting needle 16. The needle jack 45 includes a butt 46 projecting upward from the needle groove. The cam mechanism 40 in Fig. 7 acts on the butt 46 of the needle jack 45. Herein, in a case where the knitting needle is a compound needle, a slider cam is also provided. Furthermore, also on the side of the back needle bed 23, a needle jack is linked to the knitting needle 17, and the cams act on a butt of the needle jack to drive the knitting needle 17. Elements on the side of the back needle bed 23 are shown in the upper portion, and those of the front needle bed 22 are shown in the lower portion, with the needle bed gap 20 interposed therebetween.

[0034] The warp cams 43F and 43B include needle raising cams 50F and 50B, guard cams 51F and 51B, and knitting cams 52F and 52B. The knitting cams 52F and 52B are situated only on the side closer to the knitting and stitch transfer cams 41F and 41B in Fig. 7. A butt path 53 is provided on the side farther from the knitting and stitch transfer cams 41F and 41B, on the warp cam 43F on the side of the front needle bed 22. The butt path 53 guides the butt 46 from a tuck-height path 53a to a plating-height path 53b.

[0035] Fig. 8 shows butt loci 54F and 54B when the carriages travel to the left. The butt locus 54F on the side of the front needle bed 22 extends from a position below the knitting cam 52F through the gap between the needle raising cam 50F and the guard cam 51F. At a peak 50Fa of the needle raising cam 50F, the butt locus 54F reaches a knit height and the most advancing position with respect to the needle bed gap 20. In a case where a knitting loop is held on the hook 18 of the knitting needle 16, the latch 26 is opened and the knitting loop is moved toward the needle shaft, and thus the knitting loop is cleared. After the peak 50Fa, the butt locus 54F returns to the tuck height. In a case where the knitting needle 16 has been selected for tuck, the peak 50Fa does not act, and thus the butt locus 54F is kept at the tuck height. After the peak 50Fa, the butt 46 is guided so as to enter the tuck-height path 53a and then the plating-height path 53b of the butt path 53. Consequently, after the travel of the carriage, the knitting needle 16 has been advanced to the needle bed gap 20 at the plating height that is slightly higher than the tuck height. On the side of the back needle bed 23, the butt does not project from the needle groove and is sunk therein such that the butt locus 54B of the needle jack extends without receiving the action of the needle raising cam 50B. Consequently, even after the

travel of the carriage, the knitting needle 17 stays pulled back into the back needle bed 23, without being advanced to the needle bed gap 20. Herein, it is also possible to end the butt locus 54F at the tuck height, without providing the butt path 53 on the side of the front needle bed 22 with the plating-height path 53b.

[0036] Fig. 9 shows butt loci 55F and 55B when the carriages travel to the right. The butt locus 55F on the side of the front needle bed 22 extends from the plating-height path 53b to the tuck-height path 53a of the butt path 53 in the opposite direction of Fig. 8. The tuck height is kept by causing the peak 50Fa of the needle raising cam 50F so as not to act, and the knitting cam 52F is caused to act thereby pulling the knitting needle 16 back into the front needle bed 22. The butt locus 55B on the side of the back needle bed 23 guides the butt so that the butt is advanced toward the needle bed gap 20 up to the knit height at a peak 50Ba of the needle raising cam 50B, and the knitting needle 17 is pulled by the knitting cam 52B back into the back needle bed 23.

[0037] Even the warp cams 42F and 42B shown in Fig. 7 can be used for knitting with the warp 15 using the knitting needles 17 on the back needle bed 23, with operations symmetrical to those in Figs. 8 and 9. Herein, the knitting needles 16 have been advanced from the front needle bed 22 to the needle bed gap 20, and the warp 15, fed from the yarn feeding tube 24 of the warp insertion mechanism 25, is hooked between the knitting needles 16. However, the hook members that are advanced from the front needle bed 22 and hook the warp 15 are not limited to the knitting needles 16. For example, a member such as a yarn guide that is advanced and retracted with respect to the needle bed gap 20 may be provided with a portion for hooking the warp 15 fed from the yarn feeding tube 24, or a member only for receiving and hooking the warp 15 may be provided. Furthermore, in a case where a compound needle is used as the knitting needle, it is also possible to hook the warp 15 on the slider by changing the path along which the slider is guided. When the hook member that is advanced to the needle bed gap 20 does not pull the warp 15 into the front needle bed 22 but releases the warp 15 at the needle bed gap 20, it is possible to form only back stitches with the knitting needles 17 on the back needle bed 23.

[0038] In Fig. 8, the knitting needles 16 on the front needle bed 22 are advanced to the needle bed gap 20 with the travel of the carriages, and then the warp 15 is hooked between the knitting needles 16. With the next travel of the carriages, the knitting needles 17 on the back needle bed 23 are advanced to the needle bed gap 20 and then retracted therefrom, and the knitting needles 16 on the front needle bed 22 are also retracted from the needle bed gap 20. However, it is also possible to advance both the knitting needles 16 on the front needle bed 22 and the knitting needles 17 on the back needle bed 23 between the knitting needles 16 to the needle bed gap 20 with the travel of the carriages, so as to hook the warp 15 between the knitting needles 16 on the front

needle bed 22, and then to simultaneously retract the knitting needles 16 on the front needle bed 22 and the knitting needles 17 on the back needle bed 23 from the needle bed gap 20 with the next travel of the carriages.

[0039] In order to enable this sort of knitting operation to be performed, the guard cam 51B for the back needle bed 23 shown in Figs. 8 and 9 may be provided with the butt path 53 as in the guard cam 51F for the front needle bed 22. When the guard cam 51B is also provided with the butt path 53, the warp cams 42F and 42B; 43F and 43B are longitudinally symmetrical. It is possible to simultaneously advance the front and back knitting needles 16 and 17 to the needle bed gap 20, to hook the warp 15 between the knitting needles 16 and 17, and then to perform knitting using the hooked warp 15 with the knitting needles 17 on the back needle bed 23, by making the butt loci on the side of the back needle bed 23 longitudinally symmetrical to the butt loci 54F and 55F on the side of the front needle bed 22.

[0040] As described above, in the warp insertable weft knitting machine 21, a pair of needle beds such as the front needle bed 22 and the back needle bed 23 are opposed to each other at the needle bed gap 20. The lace bar 37 can feed a knitting yarn that can act as the warp 15 only to one of the needle beds such as the front needle bed 22. The weft knitting machine 21 includes hook members such as the knitting needles 16, advancement drive means such as the warp cams 42F and 43F, and knitting drive means such as the warp cams 42B and 43B. A plurality of hook members are arranged on the one of the needle beds, and can be advanced to the needle bed gap 20. The advancement drive means advances the hook members to the needle bed gap 20, at positions on both sides of an area in which knitting is performed at the other of the needle beds such as the back needle bed 23. A knitting yarn fed from the lace bar 37 can be hooked between the hook members which are advanced to the needle bed gap 20. In a state where the knitting yarn has been hooked between the hook members, it is possible to perform knitting using the other of the needle beds, without using a special yarn guide apparatus or the like, by driving the knitting needles 17 with the knitting drive means such that the knitting needles 17 are advanced from the other of the needle beds at positions between the hook members and knit a fabric using the hooked knitting yarn. For example, even when only face stitches can be formed with the knitting needles 16 on the one of the needle beds, back stitches also can be formed with the knitting needles 17 on the other of the needle beds.

[0041] The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and the range of equivalency of the claims are

therefore intended to be embraced therein.

Industrial Applicability

[0042] According to the invention, in a needle bed gap, hook members can be advanced from one of the needle beds of the needle beds at positions on both sides of an area in which knitting is performed at another of the needle beds, and a knitting yarn fed from a lace bar can be hooked between the hook members. In a state where the knitting yarn is hooked between the hook members, it is possible to perform knitting using a knitting needle on the other of the needle beds, without using a special yarn guide apparatus or the like, by driving the knitting needle on the other of the needle beds such that the knitting needle that has been advanced to the needle bed gap is retracted therefrom between the hook members. The knitting needle on the other of the needle beds may be advanced to the needle bed gap, either before or after the knitting yarn is hooked between the hook members. For example, even when only face stitches can be formed with a knitting needle on the one of the needle beds, back stitches also can be formed with the knitting needle on the other of the needle beds.

[0043] Furthermore, according to the invention, the hook members are advanced from the one of the needle beds at positions inside the needle bed gap on both sides of an area in which knitting is performed at the other of the needle beds. The knitting needle is advanced from the other of the needle beds to a position within this area inside the needle bed gap. The knitting yarn is fed from the lace bar so as to be hooked between the hook members which are advanced from the one of the needle beds to the needle bed gap. A fabric is knitted with the knitting needle which is advanced from the other of the needle beds to the needle bed gap, using the knitting yarn hooked between the hook members. Thus, it is possible to perform knitting using the other of the needle beds, without using a special yarn guide apparatus or the like.

[0044] Furthermore, according to the invention, after the knitting yarn fed from the lace bar is hooked between the hook members which are advanced from the one of the needle beds to the needle bed gap, the knitting needle is advanced from the other of the needle beds to a position between the yarn feeding members. Thus, it is possible to knit a fabric using the knitting yarn fed from the lace bar also with the knitting needle on the other of the needle beds.

[0045] Furthermore, according to the invention, knitting needles on the one of the needle beds are used as the hook members. Thus, it is possible to perform knitting using the knitting needle on the other of the needle beds, in the basic configuration of conventional weft knitting machines.

[0046] Furthermore, according to the invention, a fabric using the knitting yarn hooked between the hook members is knitted also with the knitting needle on the one of the needle beds. Thus, it is possible to knit rib, links, or

other structures using the knitting yarn fed as a warp, with the knitting needles on both needle beds that are opposed to each other with the needle bed gap interposed therebetween.

Claims

1. A warp insertable weft knitting machine comprising a pair of needle beds which are opposed to each other at a needle bed gap and a lace bar capable of feeding a knitting yarn that can act as a warp only to one of the needle beds, comprising:

a plurality of hook members that are arranged on the one of the needle beds and can be advanced to the needle bed gap;

advancement drive means which drives the hook members such that the hook members are advanced from the one of the needle beds to the needle bed gap, at positions on both sides of an area in which knitting is performed with knitting needles on the other of the needle beds; and

knitting drive means which drives the knitting needles such that the knitting needles are advanced from the other of the needle beds and knits a fabric using a knitting yarn that is fed from the lace bar and hooked between the hook members.

2. A knitting method in a warp insertable weft knitting machine comprising a pair of needle beds which are opposed to each other at a needle bed gap and a lace bar capable of feeding a knitting yarn that can act as a warp only to one of the needle beds, wherein knitting is also performed on the other of the needle beds using the knitting yarn fed from the lace bar, comprising:

advancing hook members from the one of the needle beds at positions inside the needle bed gap on both sides of an area in which knitting is performed with knitting needles on the other of the needle beds;

advancing the knitting needles from the other of the needle beds at a position in the area in which knitting is performed inside the needle bed gap; feeding a knitting yarn from the lace bar such that the knitting yarn is hooked between the hook members which are advanced from the one of the needle beds to the needle bed gap; and knitting a fabric using the hooked knitting yarn with the knitting needles which are advanced from the other of the needle beds to the needle bed gap.

3. The method of claim 2, wherein the knitting needles

on the other of the needle beds are advanced to the needle bed gap, after the hook members are advanced from the one of the needle beds to the needle bed gap and the knitting yarn fed from the lace bar is hooked between the hook members.

4. The method of claim 2 or 3, wherein the knitting needles on the one of the needle beds are used as the hook members.

5. The method of any one of claims 2 to 4, wherein a fabric using the knitting yarn hooked between the hook members is knitted also with the knitting needles on the one of the needle beds.

FIG. 1

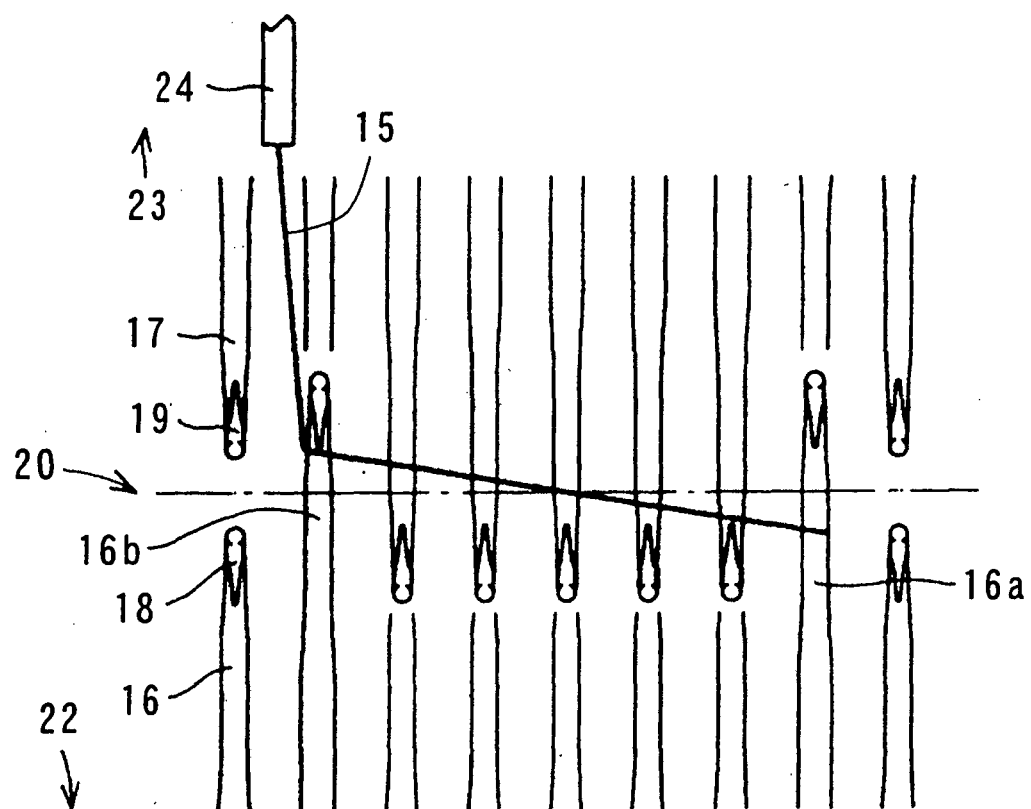


FIG. 2

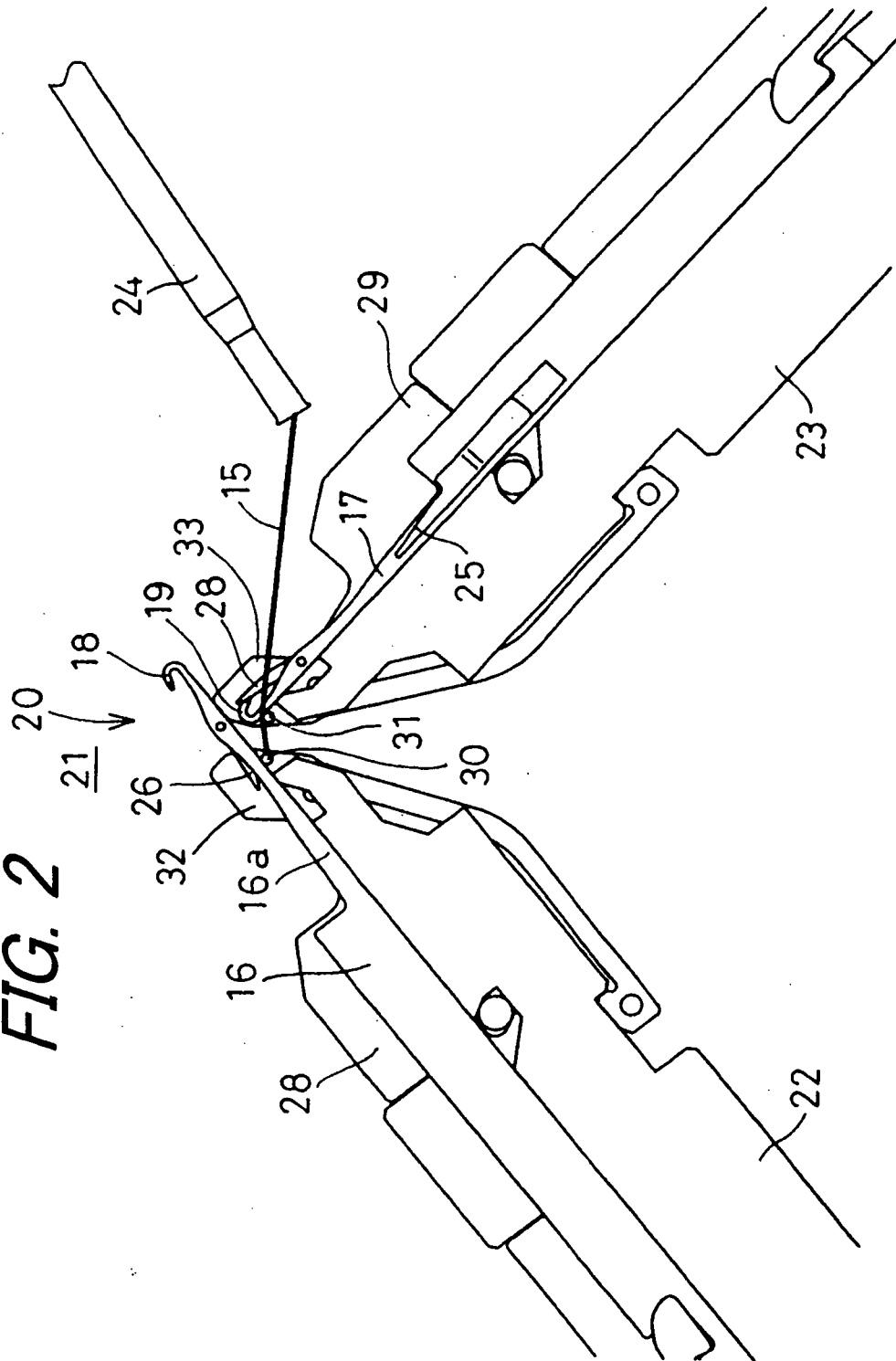


FIG. 3

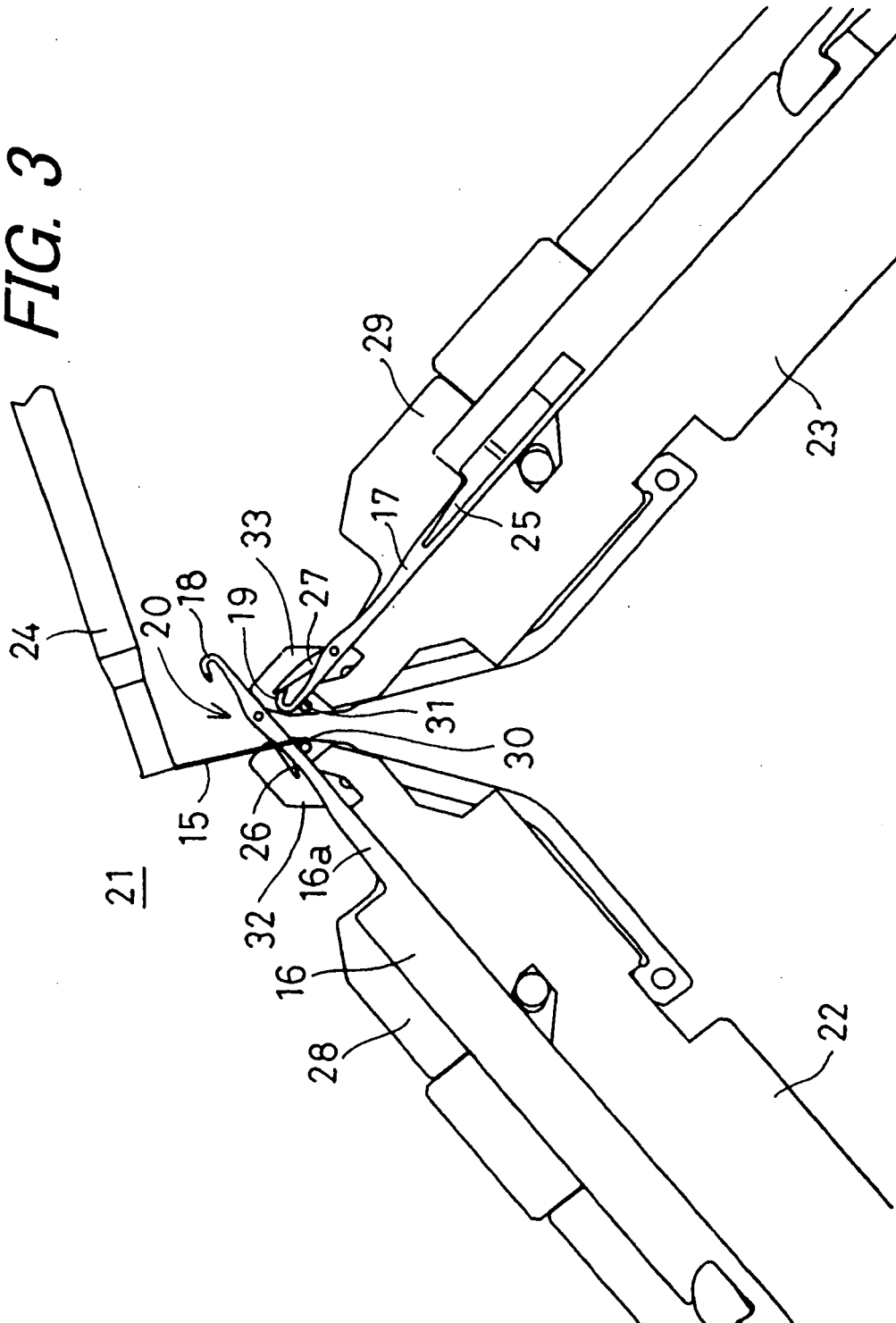


FIG. 4

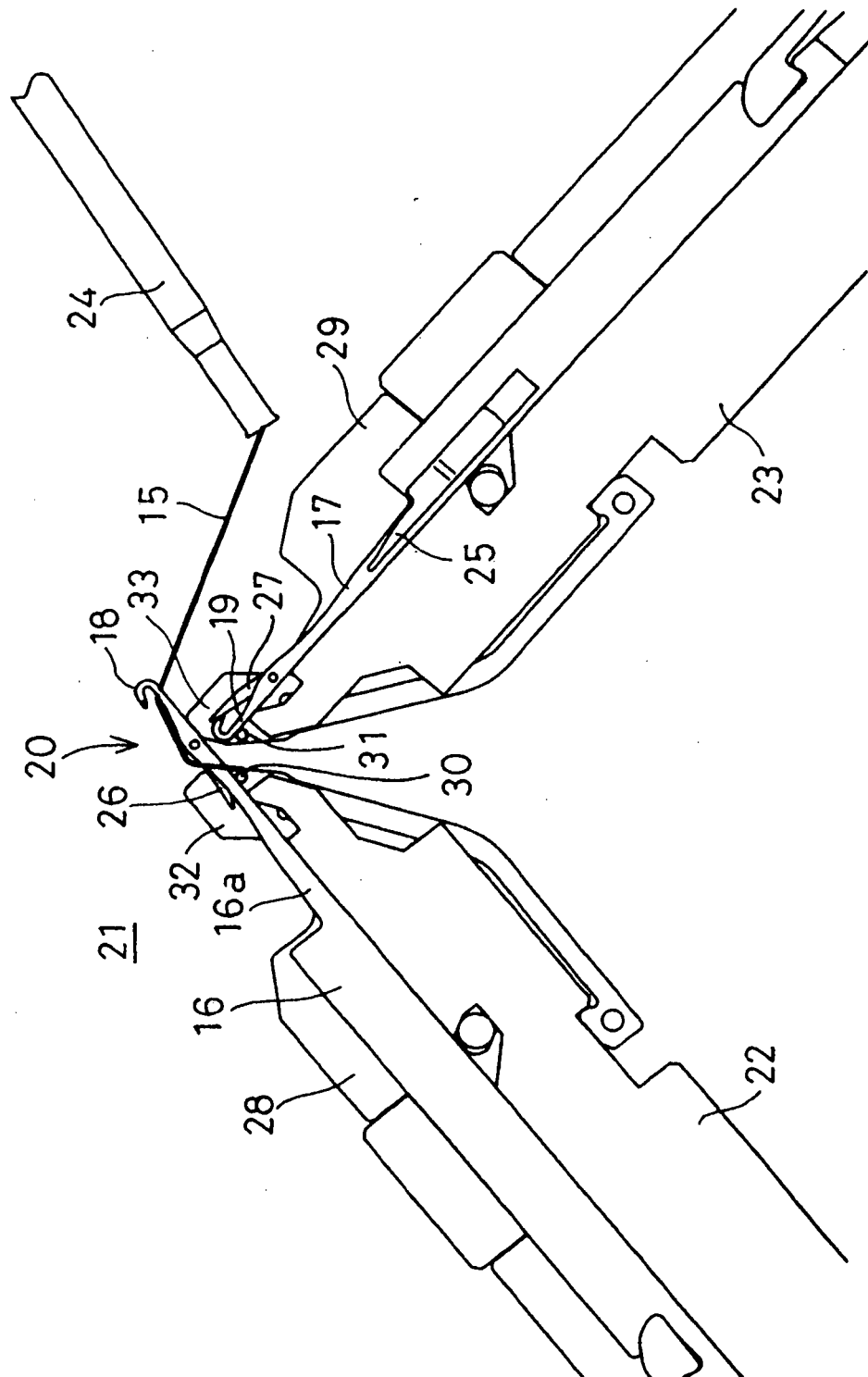
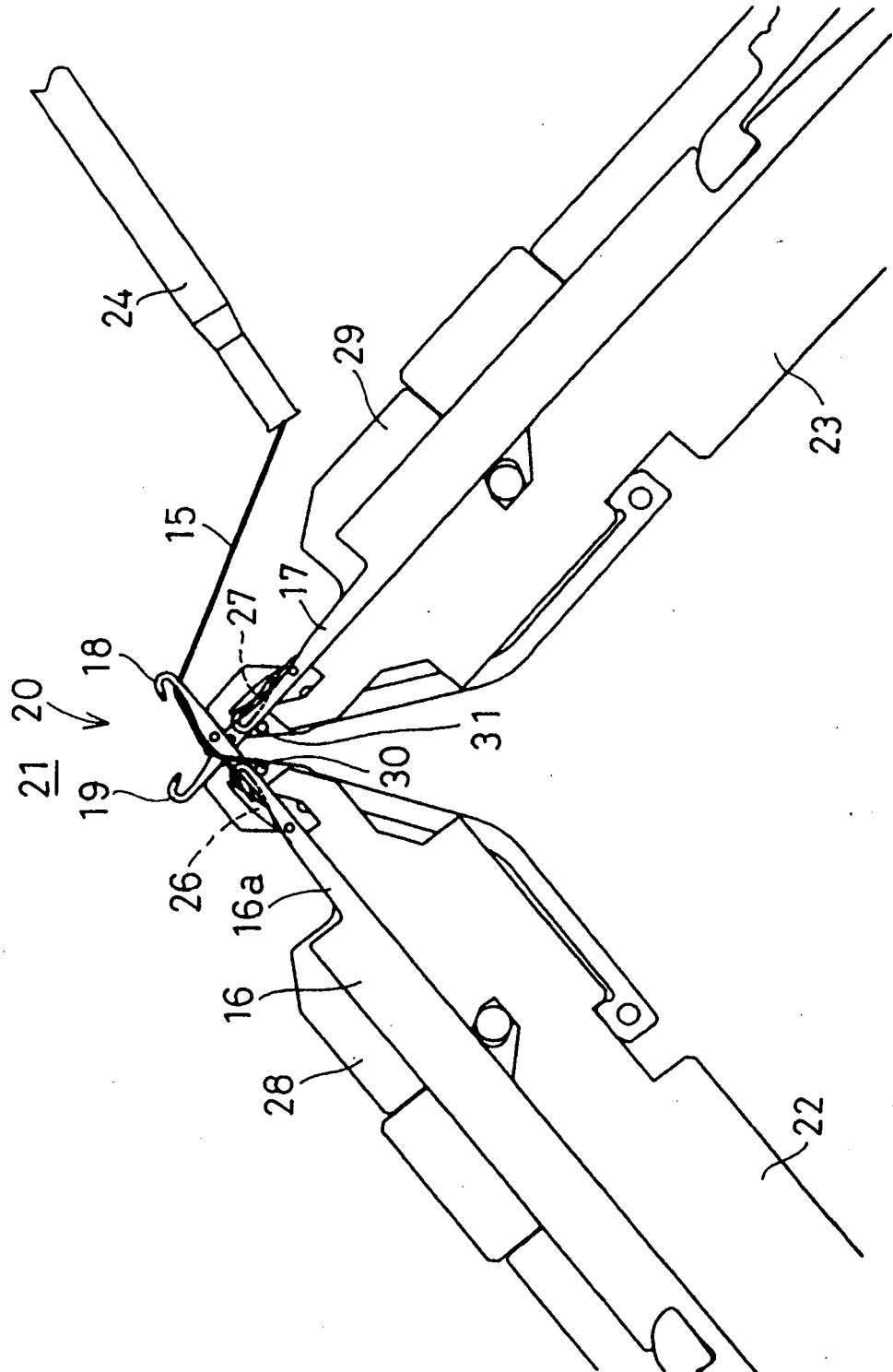


FIG. 5



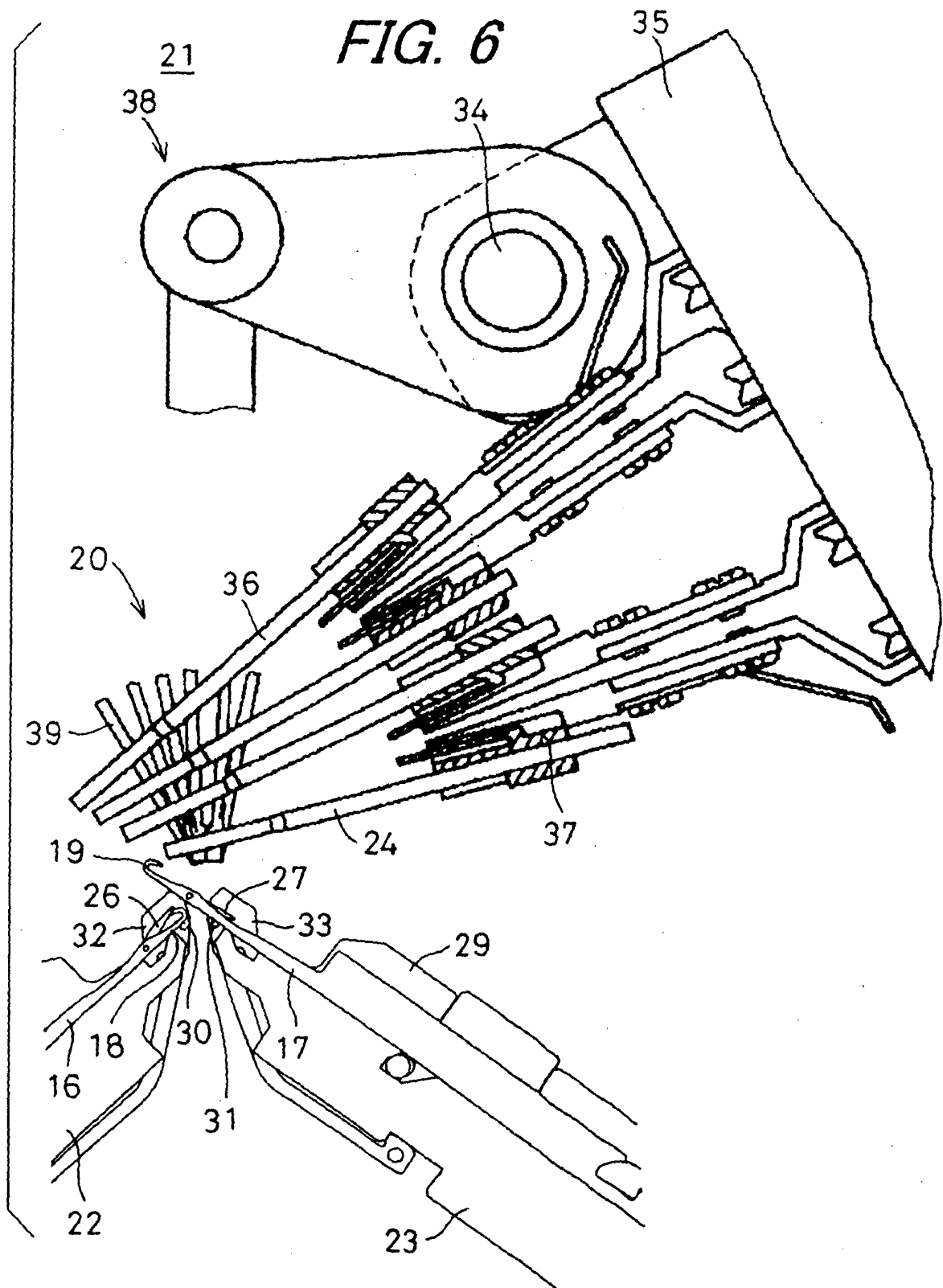


FIG. 7

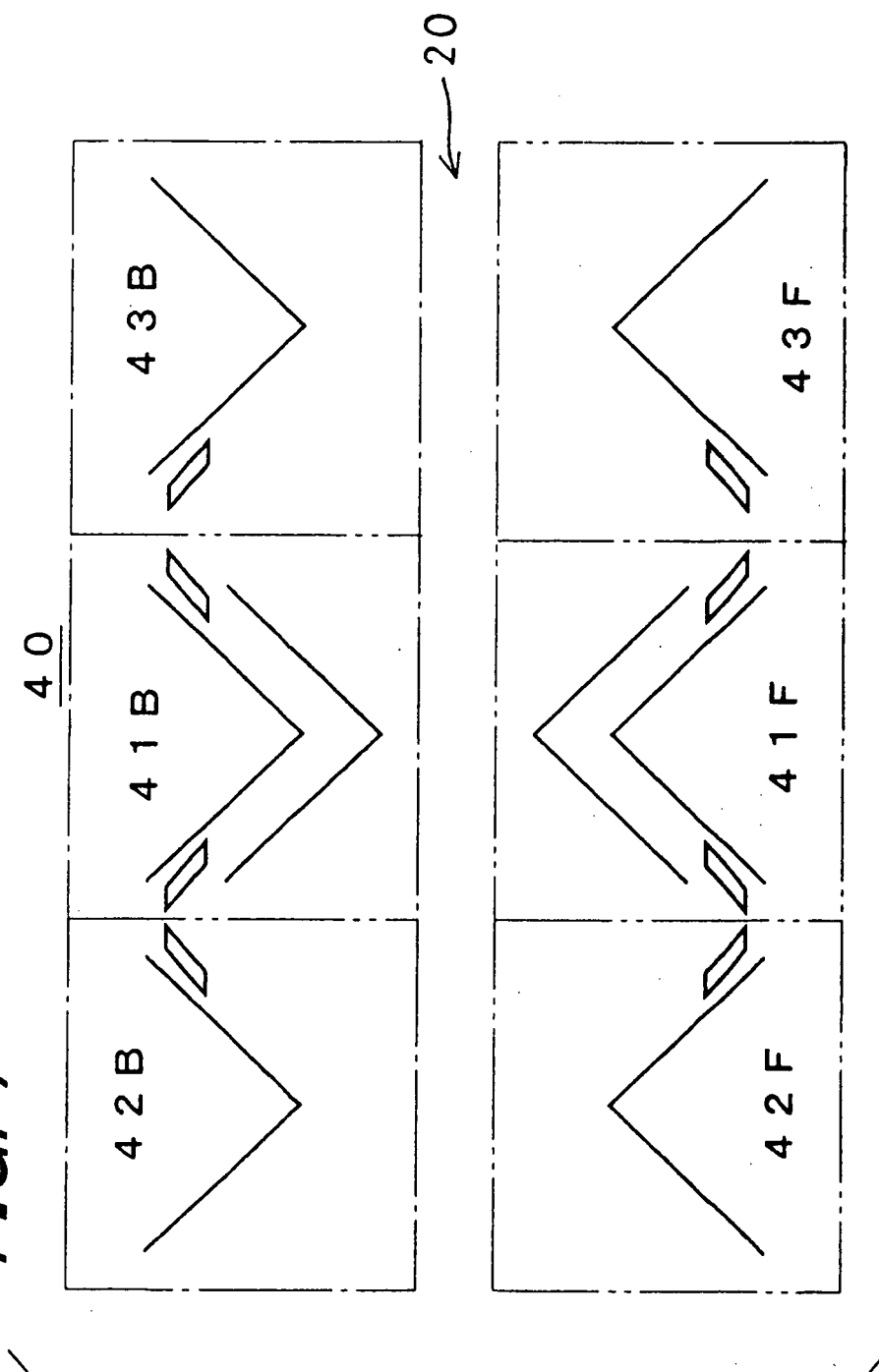


FIG. 8

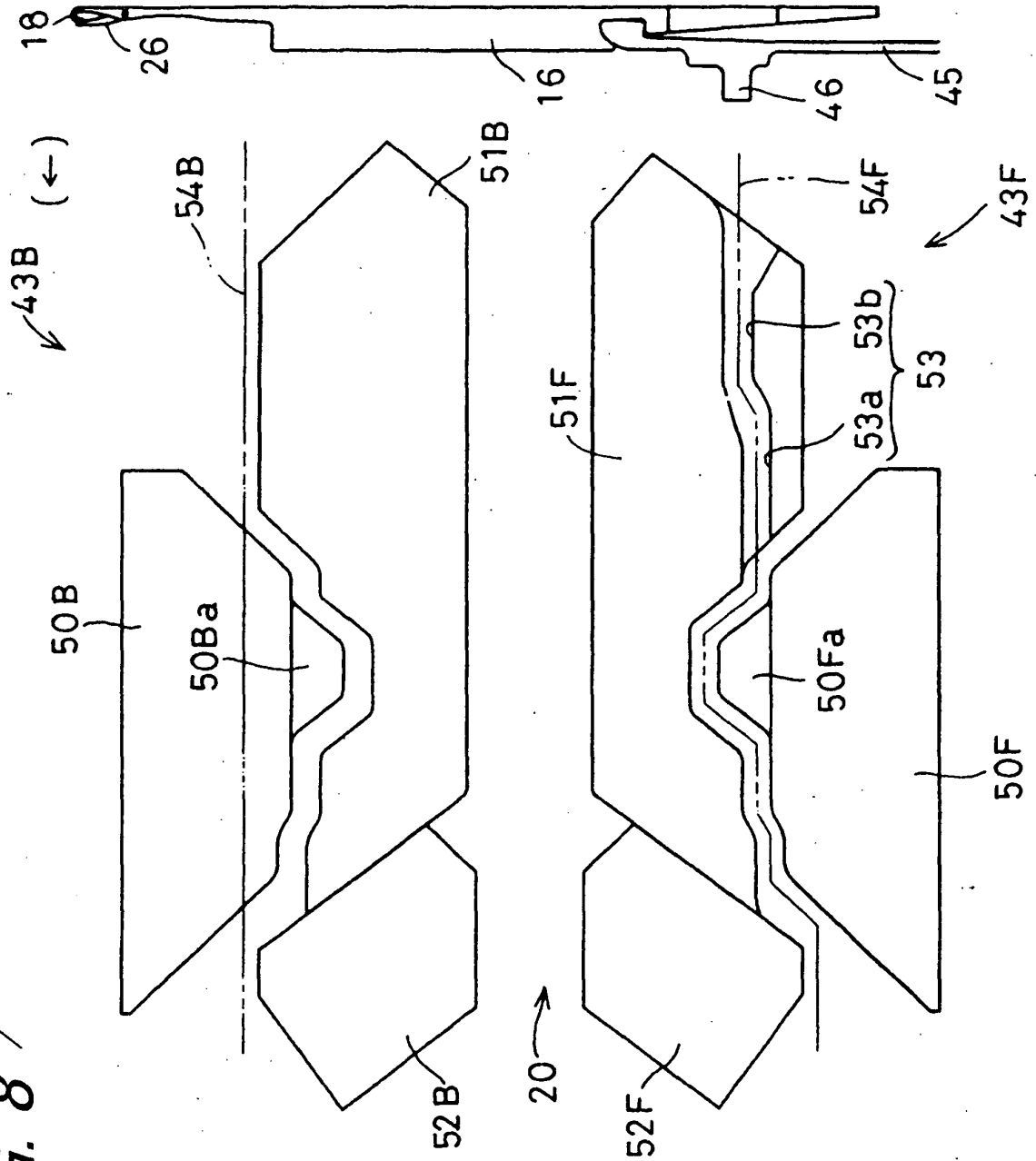


FIG. 9

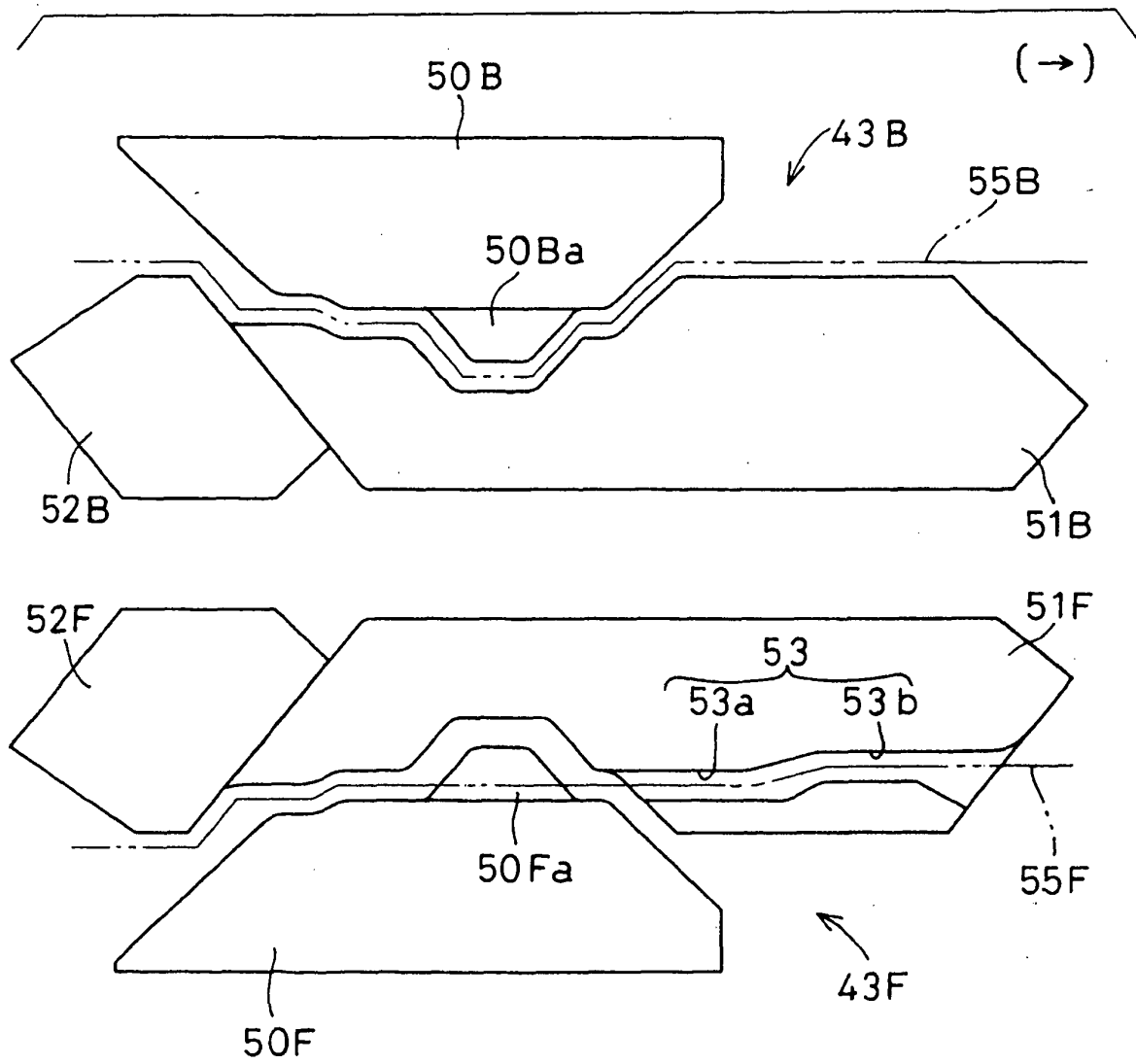
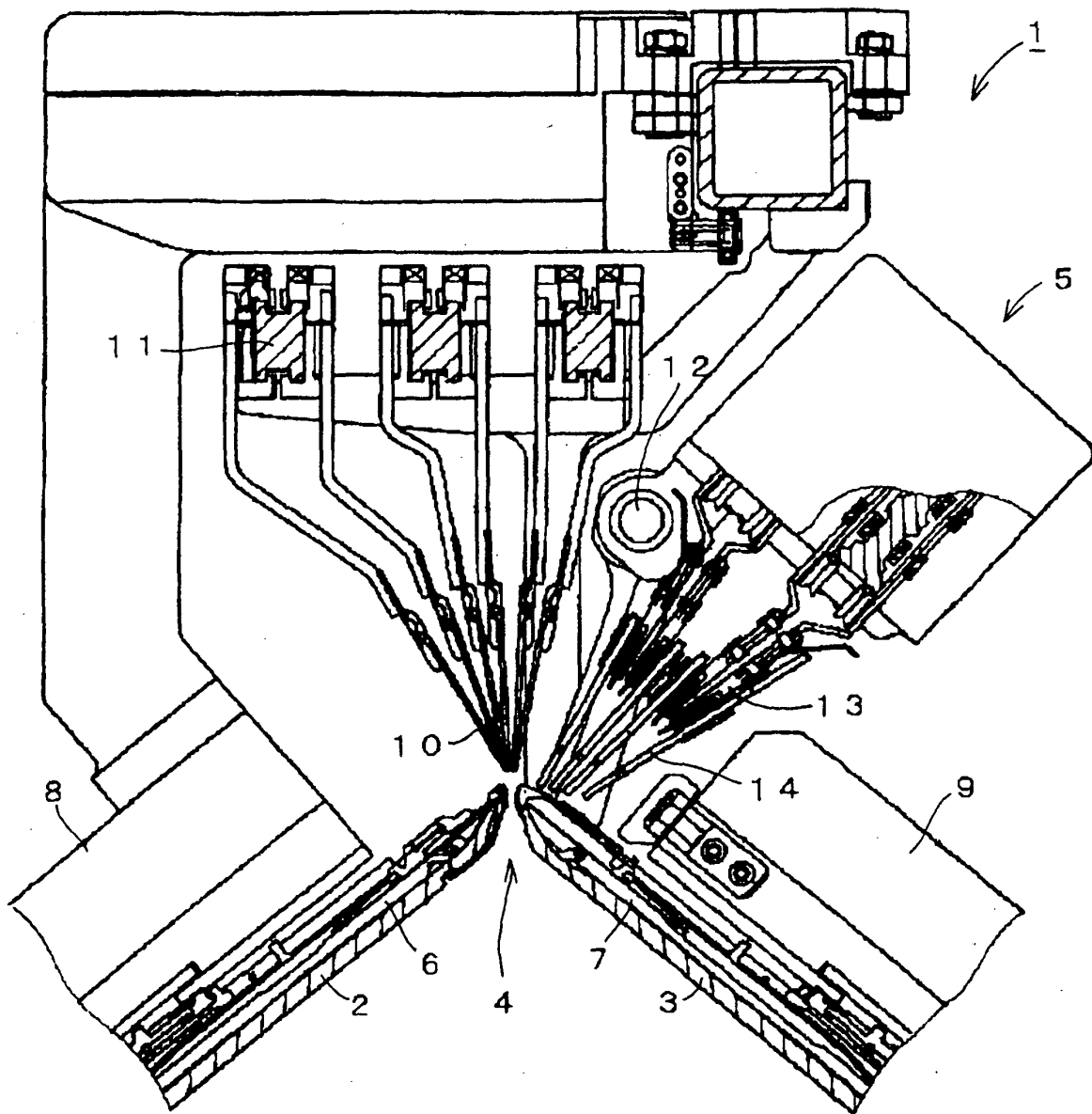


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/322889

A. CLASSIFICATION OF SUBJECT MATTER

D04B7/14(2006.01) i, D04B15/56(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)

D04B7/12-7/18, D04B15/56

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	1996-2006
Kokai Jitsuyo Shinan Koho	1971-2006	Toroku Jitsuyo Shinan Koho	1994-2006

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 3452639 B2 (Shima Seiki Mfg., Ltd.), 29 September, 2003 (29.09.03), & US 5544502 A & EP 682133 A1 & DE 69503831 C & KR 161162 B	1 2-5
A	JP 51-42225 B2 (Kabushiki Kaisha Shima Idea Center), 15 November, 1976 (15.11.76), (Family: none)	2-5
A	JP 34-4254 Y1 (Toshiro SUMIDA), 27 March, 1959 (27.03.59), (Family: none)	2-5
A	JP 2005-290572 A (Shima Seiki Mfg., Ltd.), 20 October, 2005 (20.10.05), & WO 2005/95697 A1	2-5



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search
30 November, 2006 (30.11.06)Date of mailing of the international search report
12 December, 2006 (12.12.06)Name and mailing address of the ISA/
Japanese Patent Office

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REFERENCES CITED IN THE DESCRIPTION

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- JP 8874146 A [0004]
- JP 8074146 A [0004] [0004] [0004]