



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
09.07.2008 Bulletin 2008/28

(51) Int Cl.:
D04B 15/56 (2006.01) D04B 15/06 (2006.01)

(21) Application number: **06810662.4**

(86) International application number:
PCT/JP2006/319204

(22) Date of filing: **27.09.2006**

(87) International publication number:
WO 2007/037285 (05.04.2007 Gazette 2007/14)

(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

(30) Priority: **28.09.2005 JP 2005282919**

(71) Applicant: **SHIMA SEIKI MANUFACTURING LIMITED**
Wakayama-shi,
Wakayama 641-8511 (JP)

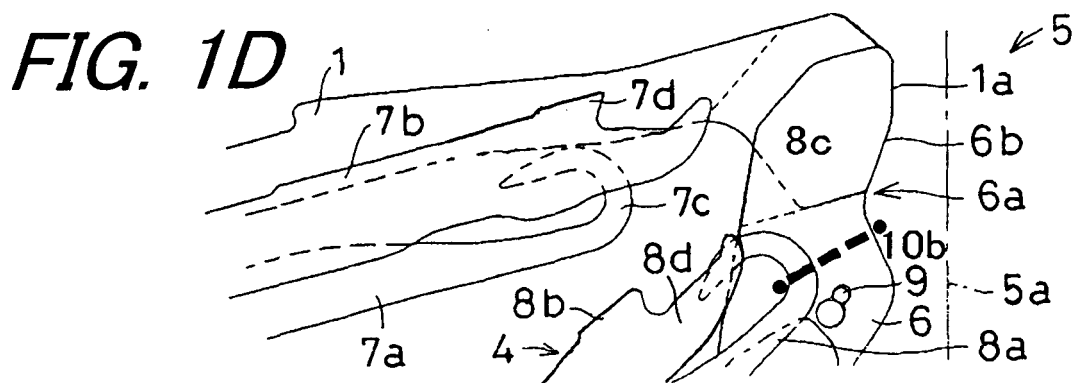
(72) Inventors:
• **KITAHARA, Kenji**
Wakayama 6418511 (JP)
• **YAMANO, Hirotoshi**
Wakayama 6418511 (JP)
• **NAKAMORI, Toshinori**
Wakayama 6418511 (JP)

(74) Representative: **Geyer, Ulrich F.**
Wagner & Geyer,
Patentanwälte,
Gewürzmühlstrasse 5
80538 München (DE)

(54) **WEFT KNITTING MACHINE HAVING MOVABLE YARN GUIDE**

(57) The invention relates to a weft knitting machine with a movable yarn guide that can prevent damage to a fabric due to undesired catch of a yarn. Since a forward movement amount of a movable yarn guide (1) to a needle bed gap (5) is reduced near a position where a yarn is fed from a yarn feeding port (10a), the yarn can be fed smoothly and the catch of the yarn by a slider (7b, 8b) can be prevented from occurring. Since a forward movement amount of the movable yarn guide (1) to the needle bed gap (5) is increased near a position where the yarn is received by a hook (7c, 8c), the yarn can be securely

caught by the hook (7c, 8c). When a needle main body (7a, 8a) is pulled into a needle bed (3, 4) and a knitted loop is formed by the hook (7c, 8c) and a front edge (6b) of a sinker (6), a guide portion (1a) at the front end is driven so as to be moved backward from the needle bed gap (5) to a position where the sinker (6) forms a sinker loop. Therefore, a lower end of the guide portion (1a) capable of securely forming the sinker loop at a stitch determination position of the sinker (6) is extended to cover a tongue (8d), thereby preventing the yarn from being caught.



Description

Technical Field

[0001] The present invention relates to a weft knitting machine provided with a movable yarn guide that moves forward and backward together with a knitting needle with respect to a needle bed gap and that guides a knitting yarn to a hook of the knitting needle.

Background Art

[0002] Conventionally, in a weft knitting machine, knitting needles are moved forward and backward with respect to a needle bed gap from needle beds that are opposed to each other so that the needle bed gap is interposed therebetween, a knitting yarn is fed from above the needle bed gap to the hooks of the knitting needles, and thus a fabric is knitted. In the needle bed gap, a knitting yarn is fed from a yarn feeding port of a yarn feeding member such as a yarn feeder in the vicinity of the center portion of the needle bed gap, in a state where a hook of a knitting needle has been moved forward to a far position in the needle bed gap. The hook of the knitting needle that has been moved forward to the needle bed gap catches a knitting yarn when the knitting needle is moved backward from the needle bed gap and pulled into the needle bed. The knitting needles form knitted loops by pulling a knitting yarn into the needle bed along needle grooves that are provided on the needle bed. The knitting loops are composed of needle loops that are formed by the hooks of the knitting needles pulling the knitting yarn into the needle bed and sinker loops that are formed by sinkers positioned between the adjacent knitting needles and facing the needle bed gap. The size of formed knitted loops is determined by stitch density to which is related pulling the hooks of the knitting needles into the needle bed. At the time of stitch determination, the position of the sinkers facing the needle bed gap serves as a reference.

[0003] For example, as disclosed in Japanese Examined Patent Publication JP-B2 3333304, a movable yarn guide member whose front end can move forward to the vicinity of the center of the needle bed gap over the front end of the sinker is used in order to reliably guide a knitting yarn to the hook. In the vicinity of the position where a knitting yarn is fed from a yarn feeding port of a yarn feeding member, the movable yarn guide member moves backward from the needle bed gap to avoid interference with the yarn feeding port. Once the knitting yarn is fed from the yarn feeding port, the movable yarn guide member moves forward to the needle bed gap and guides the knitting yarn to the hook. Also at the time of forming a knitted loop, a state is kept in which the movable yarn guide member has moved forward to the needle bed gap. The lower portion of the front end of the movable yarn guide member is formed so as not to interfere with a path through which a knitting yarn is pulled by the hook, in

order not to block the path even when the movable yarn guide member moves forward to the needle bed gap. According to JP-B2 3333304, a sinker is also a movable sinker that is swingingly displaced about a supporting point provided closer to the front end of the needle bed, and the front end portion that is swingingly displaced also has an action of pressing the fabric downward in the needle bed gap.

[0004] Furthermore, as the knitting needle, a compound needle is used in which a needle main body and a slider are separated, and a hook provided at the front end of the needle main body is opened and closed with the slider. In the compound needle, the needle main body and the slider are independently driven, and the slider remains in the vicinity of the front end of the needle bed during a period in which the hook of the needle main body has moved forward to the needle bed gap. It should be noted that when the needle main body moves forward to a knit position in the needle bed gap, an already-formed knitted loop remains on the slider as a previous loop. When a new loop is hooked on the hook and the hook is pulled into the needle bed, the hook is closed with the slider, the previous loop is knocked-over, and a fabric is knitted. Thus, when the needle main body has moved forward to the needle bed gap, it is necessary for the slider to move forward to the vicinity of the needle bed gap such that the knocked-over previous loop can easily escape to the needle bed gap. Herein, in a case where a knitting yarn before hooked on the hook is caught by the slider, the knitting yarn may be not hooked on the hook. The movable yarn guide such as the movable guide member also has an action of preventing a knitting yarn from being caught by the slider.

[0005] In the weft knitting machine, the needle beds are opposed to each other so that the needle bed gap is interposed therebetween. The reason for this is to make it possible to knit a fabric in so-called rib knitting or rib stitch using knitting needles of both needle beds, by knitting face stitches and back stitches of stitches with the knitting needles of the respective needle beds, and to knit various fabric patterns also using stitch transferring. Recently, tubular fabrics have been also knitted using both needle beds.

[0006] Furthermore, for example, as disclosed in Japanese Examined Patent Publication JP-B2 7-96740 (1995), a weft knitting machine also has been developed in which two upper and lower needle beds are respectively provided on both sides that are opposed to each other so that a needle bed gap is interposed therebetween, that is, four needle beds in total are used, in order to knit a tubular fabric with various fabric patterns. In JP-B2 7-96740, a common movable sinker for double-stage needle beds is used, and a movable yarn guide is not used.

[0007] In a weft knitting machine, as a knitting yarn, it is also required to use various fancy yarns called, for example, fancy twisted yarns. Examples of the fancy twisted yarns include knot yarns in which knots are

formed at intervals and loop yarns in which loops made of a wound yarn are continuously wound around a core yarn.

Interlaced yarns are also used that are produced by interlacing yarns through an air-jet. These yarns occupy a larger space than ordinary twisted knitting yarns.

Thus, when a part of these yarns is hooked on a hook and pulled into a needle bed, these yarns are easily caught by a slider or the like in the vicinity of a stitch determination position.

[0008] Moreover, there is a case in which knitting is performed simultaneously using a plurality of knitting yarns, and examples thereof include plating stitch that uses two knitting yarns and multiple yarn stitch that uses a larger number of thin knitting yarns. When this sort of knitting yarn is used, as a sinker, a fixed sinker having a recess is used such that the position of a knitting yarn is stable at the time of stitch determination. However, in a case where the sinker has a recess, the recess allows the slider to easily project or move closer to the needle bed gap, and thus a knitting yarn is more easily caught by the slider. The movable yarn guide member as described in JP-B2 3333304 is formed so as not to interfere with a path through which a knitting yarn is pulled, in order not to block the hook pulling the knitting yarn even when the movable yarn guide member moves forward to the needle bed gap. Thus, the movable yarn guide member hardly contributes to preventing a knitting yarn from being caught by the slider. A configuration is also conceivable in which the front end of the movable yarn guide member is extended so as to interfere with the path through which the knitting yarn is pulled, in order to separate the knitting yarn and the front end of the slider as much as possible not only when the slider projects from the recess of the fixed sinker to the needle bed gap but also when the slider does not project. However, when the knitting yarn is pulled by the hook into the needle bed at the time of stitch determination, the knitting yarn is caught by the front end of the movable yarn guide member that has moved forward to the needle bed gap over the fixed sinker, and a sinker loop is formed at a position farther in the needle bed gap than the fixed sinker.

[0009] In a case where even a part of a fancy twisted yarn or a knitting yarn in multiple yarn stitch is caught by the slider, the caught portion is damaged, and the fabric that is being knitted also may be damaged. Furthermore, in a case where double-stage needle beds are provided as in a four-bed weft knitting machine, the forward movement of the slider with respect to the needle bed gap is more complicated than the case of a single-stage needle bed, and thus a knitting yarn is more easily caught.

Disclosure of Invention

[0010] It is an object of the invention to provide a weft knitting machine with a movable yarn guide that can guide a knitting yarn to a hook in a needle bed gap the same as a conventional movable yarn guide member and that

can prevent damage to a fabric due to undesired catch of a knitting yarn.

[0011] The invention is directed to a weft knitting machine with a movable yarn guide in which a knitting needle is a compound needle comprising a needle main body and a slider, the needle main body is moved forward and backward with respect to a needle bed gap, a hook at a front end of the needle main body receives a knitting yarn fed from a yarn feeding port, a sinker for forming a sinker loop when forming a knitted loop by pulling the hook into a needle bed is provided on the needle bed gap side on the needle bed, and the movable yarn guide moves forward and backward together with the knitting needle with respect to the needle bed gap to guide a knitting yarn to the hook, the weft knitting machine comprising:

drive means for driving the movable yarn guide forward and backward with respect to the needle bed gap, the drive means driving the movable yarn guide in conjunction with the knitting needle such that in the vicinity of a position where the needle main body starts to be pulled into the needle bed and a knitting yarn is received by the hook, the movable yarn guide is moved forward to the needle bed gap, and such that when the needle main body is pulled into the needle bed and a knitted loop is formed by the hook and a front end of the sinker, a front end of the movable yarn guide facing the needle bed gap is moved backward from the needle bed gap to the position of the front end of the sinker forming a sinker loop,

wherein the front end of the sinker on the needle bed gap side forming a sinker loop is provided with a recess at which knitting yarns are collected in a case where a plurality of knitting yarns are fed, and

when the movable yarn guide is moved backward to the position of the front end of the sinker, a shape of the front end facing the needle bed gap of the movable yarn guide is at least partially matched to a shape of the front end on the needle bed gap side of the sinker continued to the recess, and the front end of the movable yarn guide can cover the front end of the slider of the knitting needle.

[0012] Furthermore, in the invention, it is preferable that in the sinker, a portion facing the needle bed gap and forming the sinker loop is in a shape of a plate, the movable yarn guide moves forward and backward with respect to the needle bed gap while at least a part of the movable yarn guide slides along the sinker, and in the portion where the movable yarn guide and the sinker slide along each other, a concavity in which the sinker and the movable yarn guide are fitted to each other is formed such that its total thickness is the same as a thickness of the plate-like sinker.

[0013] Furthermore, in the invention, it is preferable that in the vicinity of a position where the needle main body has moved forward to the needle bed gap and a knitting yarn is fed from the yarn feeding port, the drive means makes an amount of the forward movement of

the movable yarn guide to the needle bed gap smaller than that in the vicinity of a position where the knitting yarn is received by the hook.

[0014] Furthermore, in the invention, it is preferable that the weft knitting machine is a four-bed weft knitting machine in which two pairs of upper and lower needle beds are provided so as to be opposed to each other in a state where the needle bed gap is interposed therebetween.

Brief description of Drawings

[0015] 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.

Figs. 1A to 1D are simplified side cross-sectional views showing an operation of a movable yarn guide 1, in a weft knitting machine 2 with the movable yarn guide 1 according to one embodiment of the invention.

Fig. 2 is a plan view showing an outline of cam mechanism, which is drive means for driving the operation of the movable yarn guide 1 and a knitting needle 8 as illustrated in Figs. 1A to 1D.

Fig. 3 is an overall side cross-sectional view in the vicinity of a needle bed gap 5 in a weft knitting machine 2 in Figs. 1A to 1D.

Fig. 4 is a side cross-sectional view showing states in which a lower knitting needle 8 is driven in the weft knitting machine 2 in Figs. 1A to 1D.

Fig. 5 is a side cross-sectional view showing states in which an upper knitting needle 7 is driven in the weft knitting machine 2 in Figs. 1A to 1D.

Fig. 6 is a plan view showing a configuration of an upper needle bed 3 in the vicinity of the needle bed gap 5 in the weft knitting machine 2 in Figs. 1A to 1D.

Fig. 7 is a plan view showing states of a knitting yarn 10b fed to a hook 7c, in correspondence with a, b, c, and d in Fig. 2.

Figs. 8A and 8B are a plan view and a side view showing an overall shape of the movable yarn guide 1 used for the weft knitting machine 2 in Figs. 1A to 1D, respectively.

Figs. 9A and 9B are a side view and a front view showing an overall shape of a sinker 6 used for the weft knitting machine 2 in Figs. 1A to 1D, respectively.

Figs. 10A and 10B are simplified side cross-sectional views showing a reason why the sinker 6 is provided with a recess 6a, and a reason why the movable yarn guide 1 has such a shape.

Figs. 11A and 11B are a side view and a front view showing examples of a combination of a movable yarn guide 41 and a fixed sinker 46, respectively.

Figs. 12A and 12B are a side view and a front view showing examples of a combination of a movable

yarn guide 51 and a fixed sinker 56, respectively.

Figs. 13A and 13B are a side view and a front view showing examples of a combination of a movable yarn guide 61 and a fixed sinker 66, respectively.

Figs. 14A and 14B are a side view and a front view showing examples of a combination of a movable yarn guide 71 and a fixed sinker 76, respectively.

Best Mode for Carrying out the Invention

[0016] Now referring to the drawings, preferred embodiments of the invention are described below.

[0017] Figs. 1A to 1D are side views showing the operation of a movable yarn guide 1, in a weft knitting machine 2 with a movable yarn guide 1 according to one embodiment of the invention. The weft knitting machine 2 is a four-bed weft knitting machine in which two pairs of upper and lower needle beds 3 and 4 are provided so as to be opposed to each other in a state where a needle bed gap 5 is interposed therebetween. The two pairs of needle beds 3 and 4 are symmetrically arranged on a front side and a back side with respect to a virtual center plane 5a in the needle bed gap 5 extending in a vertical direction. In the weft knitting machine 2, a side on which the front pair of the needle beds 3 and 4 is arranged is taken as a front side. Each of the needle beds 3 and 4 is shown in a simplified manner. A movable yarn guide 1 is provided on the upper needle bed 3. A fixed sinker 6 is supported on the lower needle bed 4. The sinker 6 is provided with a recess 6a used for precisely performing stitch determination for knitting yarns in multiple yarn stitch or the like. On the upper and lower needle beds 3 and 4, knitting needles 7 and 8 that are compound needles are respectively arranged so as to be movable forward and backward with respect to the needle bed gap 5. The knitting needles 7 and 8 respectively include needle main bodies 7a and 8a and sliders 7b and 8b. The front ends of the needle main bodies 7a and 8a are respectively provided with hooks 7c and 8c. The front ends of the sliders 7b and 8b are respectively provided with tongues 7d and 8d that open and close the hooks 7c and 8c.

[0018] Each of the needle beds 3 and 4 is disposed such that a longitudinal direction thereof is perpendicular to the sheet of the drawing. A large number of needle grooves are formed in the longitudinal direction on the needle beds 3 and 4, and the knitting needles 7 and 8 are respectively accommodated in the needle grooves. Carriage travel back and forth in the longitudinal direction on the needle beds 3 and 4, and cam mechanisms mounted on the carriages drive the knitting needles 7 and 8 and the movable yarn guide 1 forward and backward with respect to the needle bed gap 5. Herein, when the knitting needles 7 and 8 are simultaneously driven from the upper and lower needle beds 3 and 4, the upper and lower knitting needles 7 and 8 mechanically interfere with each other, and thus either one of the knitting needles 7 and 8 is selectively driven. A front edge of the upper and lower

needle beds 3 and 4 facing the needle bed gap 5 is substantially formed by a wire material 9 such as a piano wire passing through in the longitudinal direction.

[0019] Fig. 1A shows a state in which the knitting needle 8 has moved forward from the lower needle bed 4 to a knit position, for example. The hook 8c of the needle main body 8a moves forward to a farther position in the needle bed gap 5 than the position where a knitting yarn is fed from a yarn feeding port 10a of a yarn feeder 10 in the vicinity of the center plane 5a in the needle bed gap 5. The yarn feeder 10 is brought by the carriage. The cam mechanism drives the knitting needle 7, 8 such that after the hook 7c, 8c of the needle main body 7a, 8a has moved forward to the farthest position in the needle bed gap 5, the hook 7c, 8c relatively passes through the position where receiving a knitting yarn fed from the yarn feeding port 10a of the yarn feeder 10. The tongue 8d of the slider 8b moves forward to the needle bed gap 5 to the vicinity of the recess 6a of the sinker 6. A guide portion 1a at the front end of the movable yarn guide 1 is longer than the movable yarn guide member in JP-B2 3333304 in the lower direction, and thus the guide portion 1a can cover the tongue 8d. It is possible to move the guide portion 1a at the front end of the movable yarn guide 1 forward to the needle bed gap 5 over a front edge 6b of the sinker 6, thereby preventing a knitting yarn from being caught by the tongue 8d of the slider 8b. Not moving the guide portion 1a of the movable yarn guide 1 forward to the needle bed gap 5 does not cause any problem. However, it is preferable to move the guide portion 1a forward within a range in which the guide portion 1a does not interfere with the yarn feeding port 10a, in order to prevent a yarn from being caught even when the yarn swings as in the case of a fancy twisted yarn or the like.

[0020] Fig. 1B shows a state in which the cam mechanism of the carriage is about to pull the needle main body 8a into the needle bed 4. When the needle main body 8a is pulled from the needle bed gap 5 into the needle bed 4, the movement range of the hook 8c includes a feeding height at which a yarn can be fed, that is, a knitting yarn 10b is fed from the yarn feeding port 10a of the yarn feeder 10 shown in Fig. 1A. Thus, the knitting yarn 10b has not been pulled yet, and can be pulled from this state. It is possible to catch the knitting yarn 10b at the hook 7c, by pulling the needle main body 8a into the needle bed 4. Since the movable yarn guide 1 moves forward to the farthest position in the needle bed gap 5 and guides the knitting yarn 10b in such a manner that the guide portion 1a pushes the knitting yarn 10b into the hook 8c, the hook 8c can reliably catch the knitting yarn 10b. Furthermore, since the portion of the guide portion 1a extending downward covers the front end of the tongue 8d of the slider 8b, the knitting yarn 10b is kept away from the tongue 8d, and thus the knitting yarn 10b can be prevented from being caught by the tongue 8d.

[0021] Fig. 1C shows a state in which the needle main body 8a is pulled into the needle bed 4, and the hook 8c

is closed by the tongue 8d of the slider 8b. In a case where a previous loop is held by the tongue 8d, knock-over is performed in which the knitting needle 8 is further pulled into the needle bed 4 to cause the previous loop to surmount a new loop inside the closed hook 8c and escape to the needle bed gap 5. The movable yarn guide 1 has moved forward to the needle bed gap 5 to the position where the hook 8c is closed by the tongue 8d, and thus a knitting yarn can be continuously prevented from being caught.

[0022] Fig. 1D shows a state in which the knitting needle 8 has been pulled into the needle bed 4 and stitch determination is performed. The guide portion 1a of the movable yarn guide 1 moves backward to a stitch determination position that is matched to the front edge 6b of the sinker 6, and a new knitted loop is formed between the hook 8c, and the front edge 6b of the sinker 6 and the guide portion 1a of the movable yarn guide 1.

[0023] Fig. 2 shows the outline of the cam mechanism, which is drive means for driving the operation of the movable yarn guide 1 and the knitting needle 8 as illustrated in Figs. 1A to 1D. The cam mechanisms are mounted on the carriages, and each include a yarn guide cam 11 and a needle main body cam 12. The needle main body cam 12 drives the needle main body 8a. Although a slider cam for driving the slider 8b is also provided, this cam is not shown in Fig. 2. Furthermore, as described later, the yarn guide cam 11 is mounted on a carriage provided on the upper needle bed 3, and the needle main body cam 12 for driving the lower knitting needle 8 is provided on a carriage for driving the lower needle bed 4. However, for the sake of convenience of this description, the yarn guide cam 11 and the needle main body cam 12 are shown as components provided on the same carriage.

[0024] The needle main body cam 12 is symmetrically disposed with respect to a center 13a of an upper cam 13. Stitch cams 14 are arranged on the left and right sides of the upper cam 13. A position of the stitch cam 14 on the downstream side in the travel direction of the carriage can be changed, and a needle main body drive butt 15 can pull the needle main body 8a toward a side of the needle bed 4 to the lower end of the inclined face obtained by the change. The needle main body drive butt 15 is provided on the needle main body 8a or a jack that is connected to the needle main body 8a. The slider 8b is moved in accordance with the position of a slider drive butt 16 that is provided on the slider 8b itself or a jack connected thereto. Herein, as described above, the slider cam is not shown in Fig. 2. A yarn guide drive butt 17 is guided by the yarn guide cam 11, and thus the movable yarn guide 1 is driven to move forward and backward with respect to the needle bed gap 5.

[0025] Positions 15a and 16a; 15b and 16b; 15c and 16c; and 15d and 16d of the needle main body drive butt 15 and the slider drive butt 16 in Fig. 2 respectively correspond to the states shown in Figs. 1A, 1B, 1C, and 1D. Positions 17a, 17b, 17c, and 17d of the yarn guide drive butt 17 are also shown as positions respectively corre-

sponding to Figs. 1A, 1B, 1C, and 1D. Herein, the yarn guide drive butt 17 corresponds to each of the movable yarn guides 1 provided on both sides of the adjacent knitting needle 8. In the yarn guide drive butt 17c corresponding to the position shown in Fig. 1C, when the carriage travels from right to left in Fig. 2, the right side driven first serves as the position where pulling into the needle bed 4 starts first. At the positions corresponding to Figs. 1B and 1C, the yarn guide drive butts 17b and 17c have moved forward to the farthest position toward a side of the needle bed gap. On the other hand, in the vicinity of the position where a knitting yarn fed from the yarn feeding port 10a is received as shown in Fig. 1A, the forward movement of the yarn guide drive butt 17a is made slightly smaller.

[0026] Fig. 3 shows the overall cross-sectional configuration in the vicinity of the needle bed gap 5 in the weft knitting machine 2. Needle plates 18 and 19 are arranged side by side on the respective needle beds 3 and 4, and the needle grooves for accommodating the knitting needles 7 and 8 are formed between the needle plates 18 and 19. The upper portions of the lower needle plates 19 are extended to connect the upper and lower needle beds 3 and 4. As in the description of Figs. 1A to 1D, the needle main body drive butt 15 and the slider drive butt 16 are described with reference to the lower knitting needle 8, but it will be appreciated that these butts are provided in a similar manner also for the upper knitting needle 7.

[0027] As described above, in the weft knitting machine 2, the needle main body 7a, 8a and the slider 7b, 8b are moved forward and backward from the needle bed 3, 4 with respect to the needle bed gap 5, the hook 7c, 8c at the front end of the needle main body 7a, 8a receives a knitting yarn fed from the yarn feeding port 10a in the needle bed gap 5, the hook 7c, 8c of the needle main body 7a, 8a is pulled into the needle bed 3, 4, and thus a knitted loop is formed. The front end of the needle bed 3, 4 is provided with the sinker 6 for forming a sinker loop. The movable yarn guide 1 moves forward and backward together with the knitting needle 7, 8 with respect to the needle bed gap 5, to guide a knitting yarn to the hook 7c, 8c. The weft knitting machine 2 with the movable yarn guide 1 includes the yarn guide cam 11 as drive means for driving the movable yarn guide 1 forward and backward with respect to the needle bed gap 5 in conjunction with the knitting needle 7, 8. In the vicinity of the position where the needle main body 7a, 8a has moved forward to the farthest position in the needle bed gap 5 and a knitting yarn is fed from the yarn feeding port 10a, the drive means makes the forward movement of the movable yarn guide 1 to the needle bed gap 5 smaller, or does not allow the forward movement, and thus feeding of a knitting yarn is not hampered. When the front end 1a of the movable yarn guide 1 has moved forward to the needle bed gap 5 over the front end of the slider 7b, 8b, a knitting yarn can be prevented from being caught by the slider 7b, 8b. In the vicinity of the position where the needle main body 7a, 8a starts to be pulled into the

needle bed 3, 4 and a knitting yarn is received by the hook 7c, 8c, the movable yarn guide 1 is moved forward to the farther position in the needle bed gap 5, and thus the knitting yarn can be reliably caught by the hook 7c, 8c of the needle main body 7a, 8a. When the needle main body 7a, 8a is pulled into the needle bed 3, 4 and a knitted loop is formed by the hook 7c, 8c and the front edge 6b of the sinker 6, the movable yarn guide 1 is driven such that the guide portion 1a at the front end facing the needle bed gap 5 is moved backward from the needle bed gap 5 to the position where the sinker 6 forms a sinker loop, and thus a sinker loop can be reliably formed at the stitch determination position of the sinker 6.

[0028] Figs. 4 and 5 show states in which the lower knitting needle 8 and the upper knitting needle 7 are driven. The lower knitting needle 8 is driven as shown in Figs. 1A to 1D and 2. The upper knitting needle 7 is driven in a basically similar manner to that of the lower knitting needle 8. The sinker 6 is provided with the recess 6a, and thus a knitting yarn can be stably held at the stitch determination position for both of the upper knitting needle 7 and the lower knitting needle 8. Even in a case where the sinker 6 is provided with the recess 6a in order to use knitting yarns in multiple yarn stitch, when the movable yarn guide 1 is pulled to move backward from the needle bed gap 5, the shape of the guide portion 1a at the front end facing the needle bed gap 5 is at least partially matched to the shape of the sinker 6 such that the guide portion 1a is continued to the recess 6a, and thus knitted loops can be formed with the plurality of knitting yarns in the same condition. Even when the recess 6a of the sinker 6 allows the slider 7b, 8b to easily project to the needle bed gap 5, the movable yarn guide 1 can prevent a knitting yarn from being caught by the slider 7b, 8b.

[0029] Fig. 6 shows the configuration of the upper needle bed 3 viewed from above in the vicinity of the needle bed gap 5. The knitting needle 7 is accommodated in a needle groove 20 between the needle plates 18. The front end of the needle bed 3 facing the needle bed gap 5 is provided with the front edge 6b of the sinker 6 supported on and extending from the lower needle bed. The sinker 6 is held and supported by a needle support 21. The guide portion 1a at the front end of the movable yarn guide 1 is guided along a groove-like path 6c formed in the middle of the thickness of the sinker 6, and moves forward to the needle bed gap 5. More specifically, at least the portion of the sinker 6 facing the needle bed gap 5 and forming a sinker loop is in the shape of a plate, the movable yarn guide 1 moves forward and backward with respect to the needle bed gap 5 while at least a part of the movable yarn guide 1 slides along the sinker 6, and the path 6c for accommodating the movable yarn guide 1 is formed in the sinker 6 such that the portion in which the movable yarn guide 1 and the sinker 6 slide along each other has the total thickness that is the same as the plate-like sinker 6. At the stitch determination position of the sinker 6, the movable yarn guide 1 and the

sinker 6 integrally operate to form a sinker loop, and act as a sinker 6 having a uniform total thickness. Thus, a sinker loop as in the case where only the sinker 6 is used can be formed. In particular, in a case where the movable yarn guides 1 and the sinkers 6 are arranged on both sides of each of the knitting needles 7 and 8 at equal intervals, it is possible to eliminate a difference caused by the travel direction of the carriage when the carriage travels along the needle beds 3 and 4 to knit a fabric. It should be noted that in the weft knitting machine 2, a pitch called 3 to 8 G at which 3 to 8 knitting needles are arranged per 25.4 mm (1 inch) is preferable in order to secure a sufficient plate thickness of the sinker 6.

[0030] In Fig. 7, [a], [b], [c], and [d] respectively show states of the knitting yarn 10b fed to the hook 7c, in correspondence with a, b, c, and d in Fig. 2.

Furthermore, [e] shows a stitch determination state. As described above, at the positions [b] and [c], the guide portion 1a of the movable yarn guide 1 has moved forward to the farthest position in the needle bed gap 5. Herein, in a case where the lower end of the guide portion 1a of the movable yarn guide 1 does not extend downward as in the movable yarn guide member in JP-B2 3333304, the knitting yarn 10b may be caught by the tongue 7d of the slider 7b as indicated by the dashed double dotted line. With the guide portion 1a of the movable yarn guide 1, the knitting yarn 10b can be kept away from the tongue 7d as indicated by the solid line.

[0031] Figs. 8A and 8B show the overall shape of the movable yarn guide 1. Fig. 8A is a plan view thereof, and Fig. 8B is a side view thereof. The front end portion of the movable yarn guide 1 including the guide portion 1a is formed thin so as to be accommodated inside the path 6c of the sinker 6 shown in Fig. 6.

[0032] Figs. 9A and 9B show the overall shape of the sinker 6. Fig. 9A is a side view thereof, and Fig. 9B is a front view thereof. The side of the sinker 6 facing the needle bed gap 5 is provided with the recess 6a, and a groove serving as the path 6c is formed in the upper half of the recess 6a. A hole 6d through which the wire material 9 passes is formed in the lower half of the recess 6a. A hole 6e used for connection to the lower needle bed 4 is formed in the vicinity of the lower end of the sinker 6. The positioning of the sinker 6 is performed at a groove 6f.

[0033] Figs. 10A and 10B show the reason why the sinker 6 is provided with the recess 6a, and the reason why the movable yarn guide 1 has the above-described shape. Fig. 10A shows an example in which the sinker 6 is provided with the recess 6a, and a conventional movable yarn guide 22 such as the movable yarn guide member in JP-B2 3333304 is used instead of the movable yarn guide 1. With the recess 6a of the sinker 6, a plurality of knitting yarns 23 in multiple yarn stitch or the like can be collected at a desired stitch determination position, and provided with a uniform loop length. Herein, in a state where the tongue 8d of the slider 8b moves forward or closer to the needle bed gap 5, there is a fear of catching

the knitting yarns 23 by the front end of the tongue 8d. In the movable yarn guide 1 of this embodiment, the lower end of the guide portion 1a is extended downward as indicated by the phantom line, and thus the guide portion 1a moves forward to the needle bed gap 5 over the tongue 8d of the slider 8b, and covers the tongue 8d as shown in Figs. 1A to 1C. Herein, with a fixed sinker 24 without a recess as shown in Fig. 10B, the positions of the knitting yarns 23 in multiple yarn stitch or the like are easily spread, and thus the lengths of loops formed between the fixed sinker 24 and the hook 8c are not uniform.

[0034] Figs. 11A to 14B show examples of the combination of a movable yarn guide and a fixed sinker. As in Figs. 8A and 8B, Figs. 11A, 12A, 13A, and 14A show side views, and Figs. 11B, 12B, 13B, and 14B show front views.

[0035] Figs. 11A and 11B show a configuration in which a guide portion 41a at the front end of a movable yarn guide 41 projects and withdraws with respect to the needle bed gap 5 from a path 46c that is open in the middle of the thickness of a sinker 46. The sinker 46 can be made of two plates attached to each other, in order to form the path 46c in the middle of the thickness.

[0036] Figs. 12A and 12B show a configuration in which the lower end of a movable yarn guide 51 is provided with a groove 51a, the upper end of a sinker 56 is provided with a protruding ridge 56a, and the groove 51a is engaged with the protruding ridge 56a.

[0037] Figs. 13A and 13B show a configuration in which a front end portion 61a of a movable yarn guide 61 is made thin, and a step 66a is formed on one side in a sinker 66 and combined with the front end portion 61a. With this configuration, the movable yarn guides 61 cannot be arranged at equal intervals even when the sinkers 66 are arranged on both sides of each knitting needle at equal intervals, but processing is easy.

[0038] Figs. 14A and 14B show a configuration in which the lower end of a movable yarn guide 71 is provided with a protruding ridge 71a, the upper end of a sinker 76 is provided with a groove 76a, and the protruding ridge 71a is engaged with the groove 76a.

[0039] In the configurations in Figs. 12A and 12B to 14A and 14B, the portion in which the movable yarn guide 51, 61, and 71 is engaged with the sinker 56, 66, and 76 has to be produced precisely without a gap or the like such that the portion does not catch a thin knitting needle in multiple stitch or the like when the movable yarn guide and the sinker integrally act to perform stitch determination of the sinker.

[0040] In the foregoing embodiments, as a weft knitting machine, the four-bed weft knitting machine 2 has been described in which the two pairs of upper and lower needle beds 3 and 4 are provided so as to be opposed to each other in a state where the needle bed gap 5 is interposed therebetween. That is to say, in the four-bed weft knitting machine 2, the two upper and lower needle beds 3 and 4 are respectively provided with the sliders 7b and 8b. Even when the sliders 7b and 8b project to

the vicinity of the needle bed gap 5, the movable yarn guide 1 can prevent a knitting yarn from being caught, and thus a fabric with no damage can be knitted. Herein, also in a case where a single-stage needle bed is used, it is possible to avoid damage to a fabric by preventing a knitting yarn from being caught by a slider, using the movable yarn guide 1.

[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, a weft knitting machine provided with a movable yarn guide includes drive means for driving the movable yarn guide forward and backward with respect to a needle bed gap in conjunction with a knitting needle. In the vicinity of the position where a needle main body starts to be pulled into a needle bed and a knitting yarn is received by a hook of the needle main body, the drive means moves the movable yarn guide forward to the needle bed gap. Thus, the knitting yarn can be guided to be hooked by the hook of the needle main body. When the needle main body is pulled into the needle bed and a knitted loop is formed by the hook and the front end of a sinker, the drive means drives the front end of the movable yarn guide backward from the needle bed gap to the position where the sinker forms a sinker loop. Thus, the sinker loop can be reliably formed at the stitch determination position of the sinker. For example, even in a case where the sinker is provided with a recess in order to use knitting yarns in multiple yarn stitch, when the movable yarn guide is pulled to move backward from the needle bed gap, the shape of the front end facing the needle bed gap is at least partially matched to the shape of the front end on the needle bed gap side of the sinker such that the movable yarn guide is continued to the recess. Thus, knitted loops can be formed with the plurality of knitting yarns in the same condition. Even when the recess of the sinker allows a slider to project to the needle bed gap, or, although not projecting, to move closer to and easily catch a knitting yarn, since the movable yarn guide can cover the front end of the slider, the knitting yarn can be kept away from the front end of the slider and prevented from being caught.

[0043] Furthermore, according to the invention, the movable yarn guide and the sinker integrally operate to form a sinker loop, and act as a plate-like sinker having a uniform total thickness. Thus, a sinker loop as in the case where only the sinker is used can be formed. In the portion where the sinker and the movable yarn guide slide along each other, a concavity in which they are fitted to

each other are formed. Thus, the sinker can mechanically support the movable yarn guide, and guide the back-and-forth movement of the movable yarn guide with respect to the needle bed gap. In particular, in a case where the sinkers and the movable yarn guides are arranged on both sides of each knitting needle at equal intervals, it is possible to eliminate a difference caused by the travel direction of the carriage when the carriage travels along the needle bed to knit a fabric.

[0044] Furthermore, according to the invention, in the vicinity of the position where the needle main body has moved forward to the needle bed gap and a knitting yarn is fed from the yarn feeding port, the drive means does not allow the movable yarn guide to move forward to the needle bed gap, or makes the amount of the forward movement smaller than that in the vicinity of the position where the knitting yarn is received by the hook. Thus, it is possible to prevent feeding of the knitting yarn from being hampered, by preventing interference between the yarn feeding port and the movable yarn guide. The front end of the movable yarn guide can cover the front end of the slider. Thus, when the movable yarn guide is moved forward to the needle bed gap over the slider, a knitting yarn can be prevented from being caught by the slider.

[0045] Furthermore, according to the invention, a four-bed weft knitting machine is used in which two upper and lower needle beds are respectively provided with sliders. Even when the slider projects to the vicinity of the needle bed gap, the movable yarn guide can prevent a knitting yarn from being caught, and thus a fabric with no damage can be knitted.

Claims

1. A weft knitting machine with a movable yarn guide in which a knitting needle is a compound needle comprising a needle main body and a slider, the needle main body is moved forward and backward with respect to a needle bed gap, a hook at a front end of the needle main body receives a knitting yarn fed from a yarn feeding port, a sinker for forming a sinker loop when forming a knitted loop by pulling the hook into a needle bed is provided on the needle bed gap side on the needle bed, and the movable yarn guide moves forward and backward together with the knitting needle with respect to the needle bed gap to guide a knitting yarn to the hook, the weft knitting machine comprising:

drive means for driving the movable yarn guide forward and backward with respect to the needle bed gap, the drive means driving the movable yarn guide in conjunction with the knitting needle such that in the vicinity of a position where the needle main body starts to be pulled into the needle bed and a knitting yarn is received by the

hook, the movable yarn guide is moved forward to the needle bed gap, and such that when the needle main body is pulled into the needle bed and a knitted loop is formed by the hook and a front end of the sinker, a front end of the movable yarn guide facing the needle bed gap is moved backward from the needle bed gap to the position of the front end of the sinker forming a sinker loop,

5

10

wherein the front end of the sinker on the needle bed gap side forming a sinker loop is provided with a recess at which knitting yarns are collected in a case where a plurality of knitting yarns are fed, and when the movable yarn guide is moved backward to the position of the front end of the sinker, a shape of the front end facing the needle bed gap of the movable yarn guide is at least partially matched to a shape of the front end on the needle bed gap side of the sinker continued to the recess, and the front end of the movable yarn guide can cover the front end of the slider of the knitting needle.

15

20

2. The weft knitting machine of claim 1, wherein in the sinker, a portion facing the needle bed gap and forming the sinker loop is in a shape of a plate, the movable yarn guide moves forward and backward with respect to the needle bed gap while at least a part of the movable yarn guide slides along the sinker, and in the portion where the movable yarn guide and the sinker slide along each other, a concavity in which the sinker and the movable yarn guide are fitted to each other is formed such that its total thickness is the same as a thickness of the plate-like sinker.
3. The weft knitting machine of claim 1 or 2, wherein, in the vicinity of a position where the needle main body has moved forward to the needle bed gap and a knitting yarn is fed from the yarn feeding port, the drive means makes an amount of the forward movement of the movable yarn guide to the needle bed gap smaller than that in the vicinity of a position where the knitting yarn is received by the hook.
4. The weft knitting machine of any one of claims 1 to 3, wherein the weft knitting machine is a four-bed weft knitting machine in which two pairs of upper and lower needle beds are provided so as to be opposed to each other in a state where the needle bed gap is interposed therebetween.

25

30

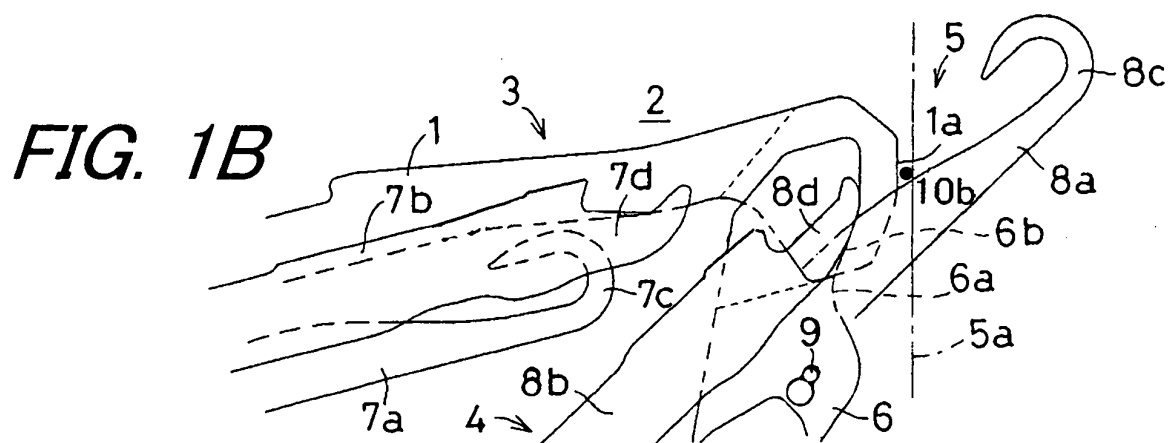
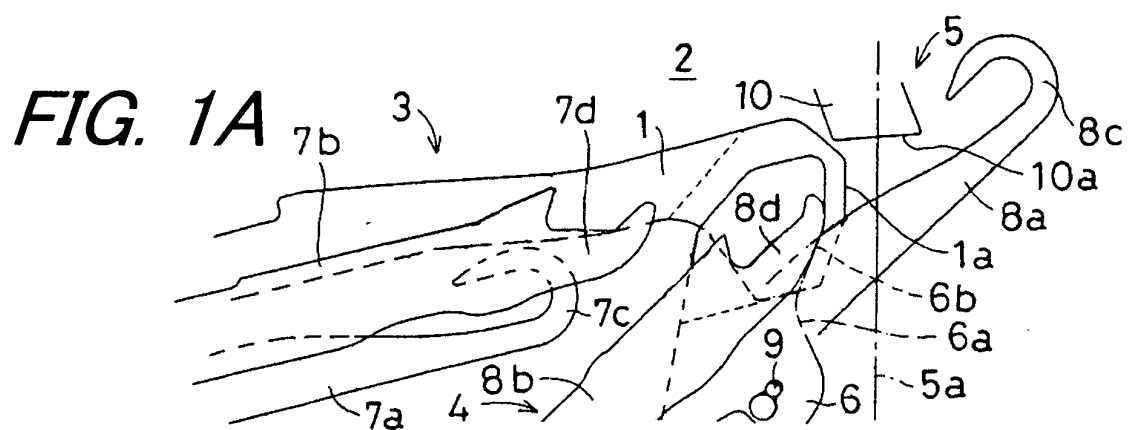
35

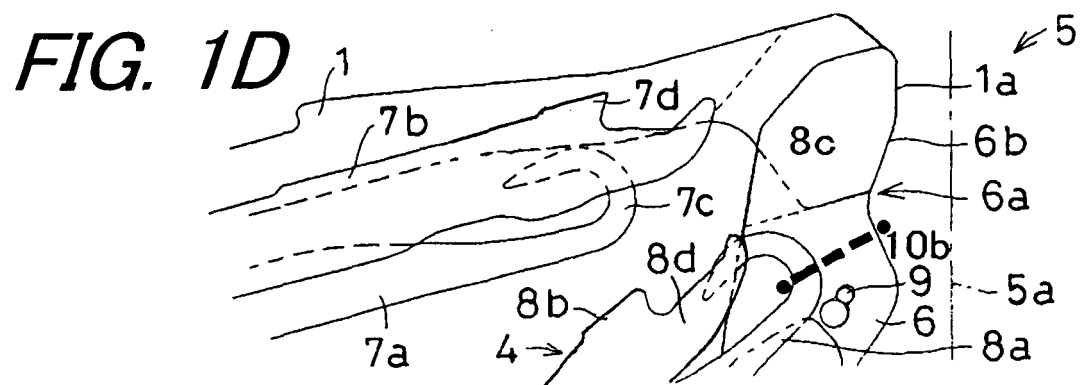
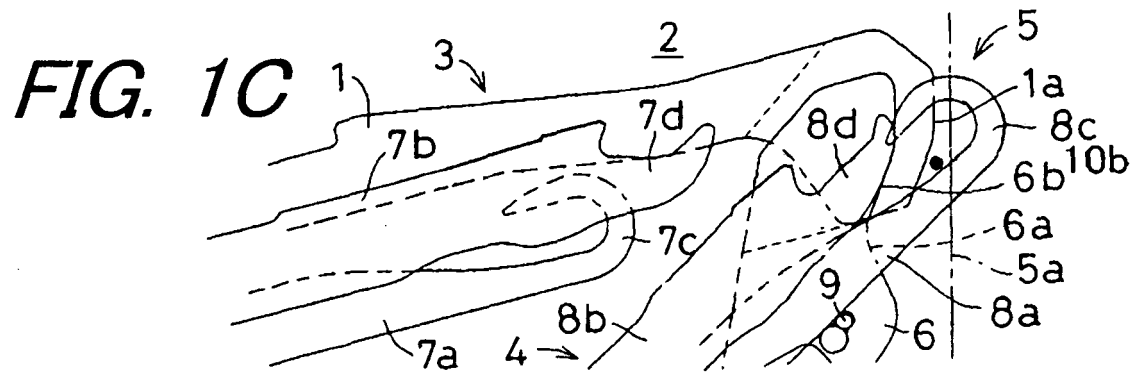
40

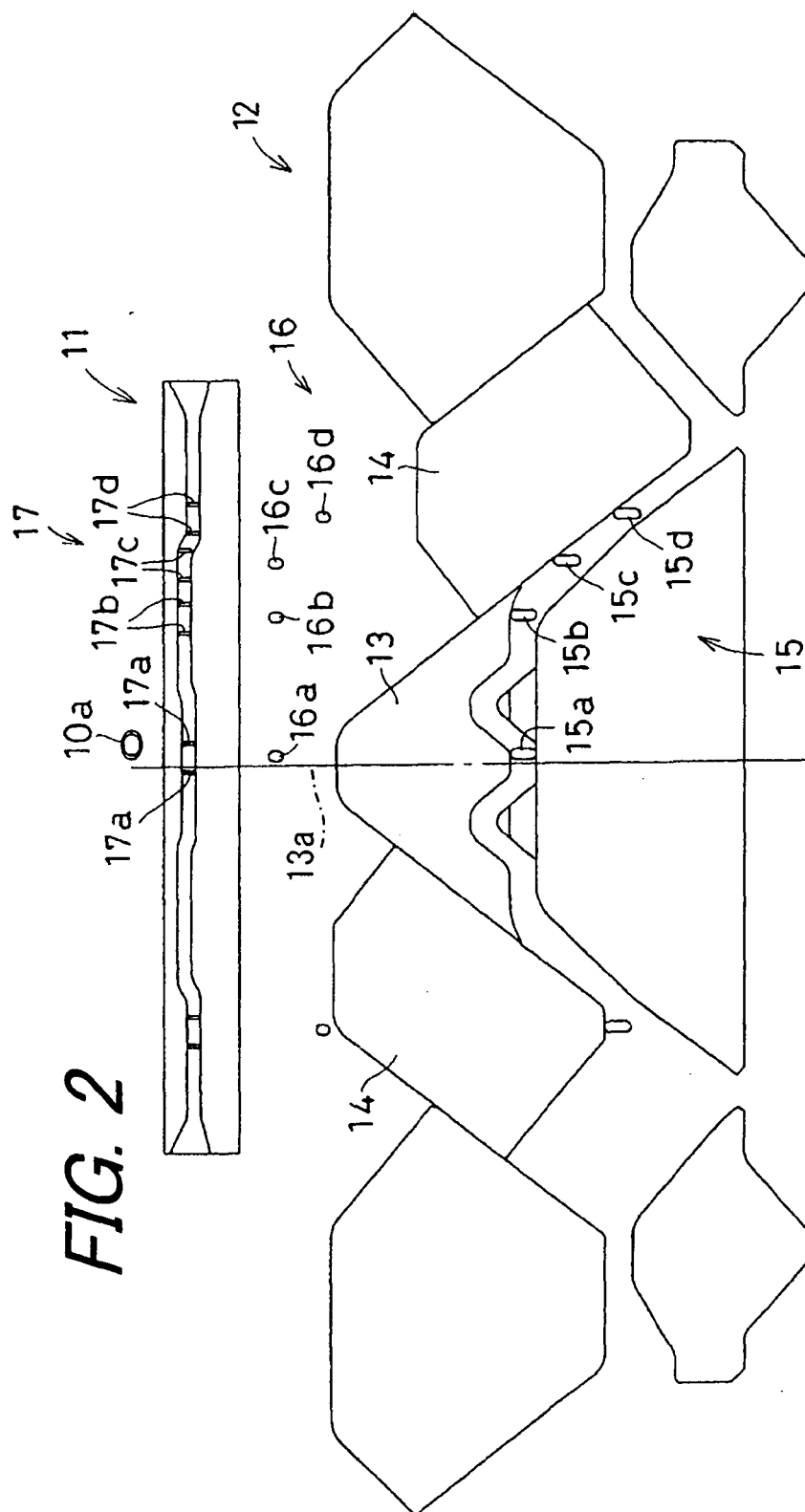
45

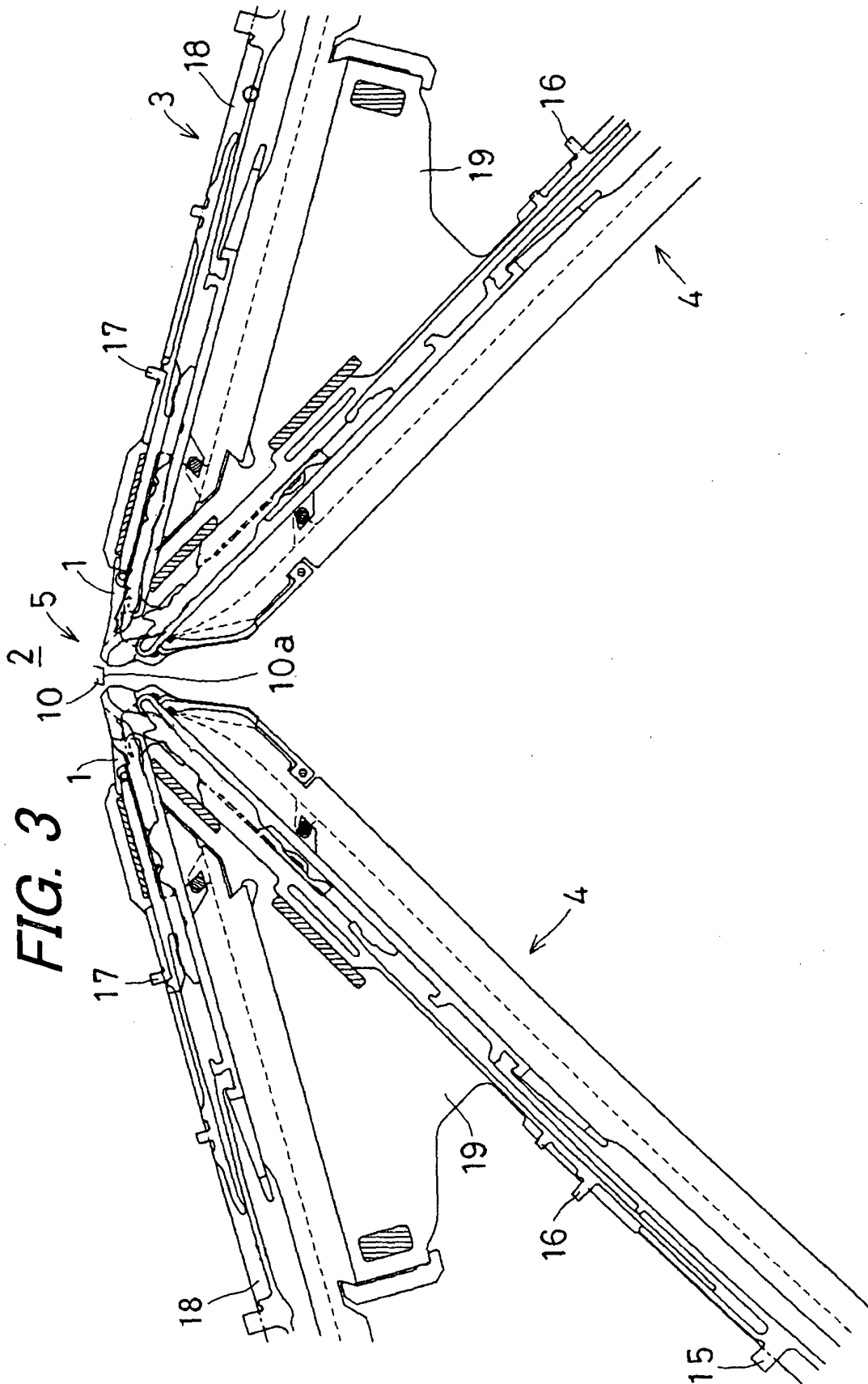
50

55









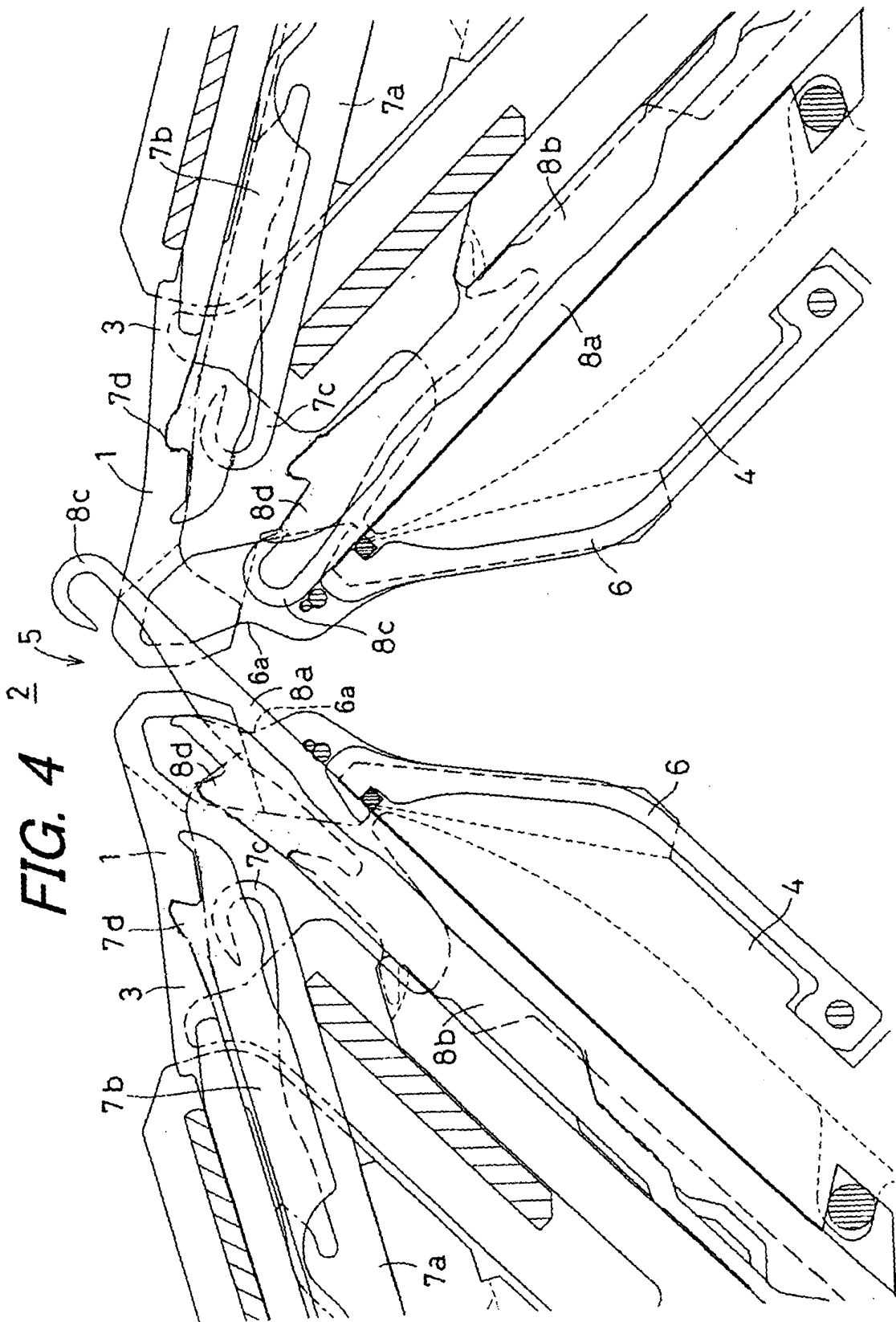


FIG. 5

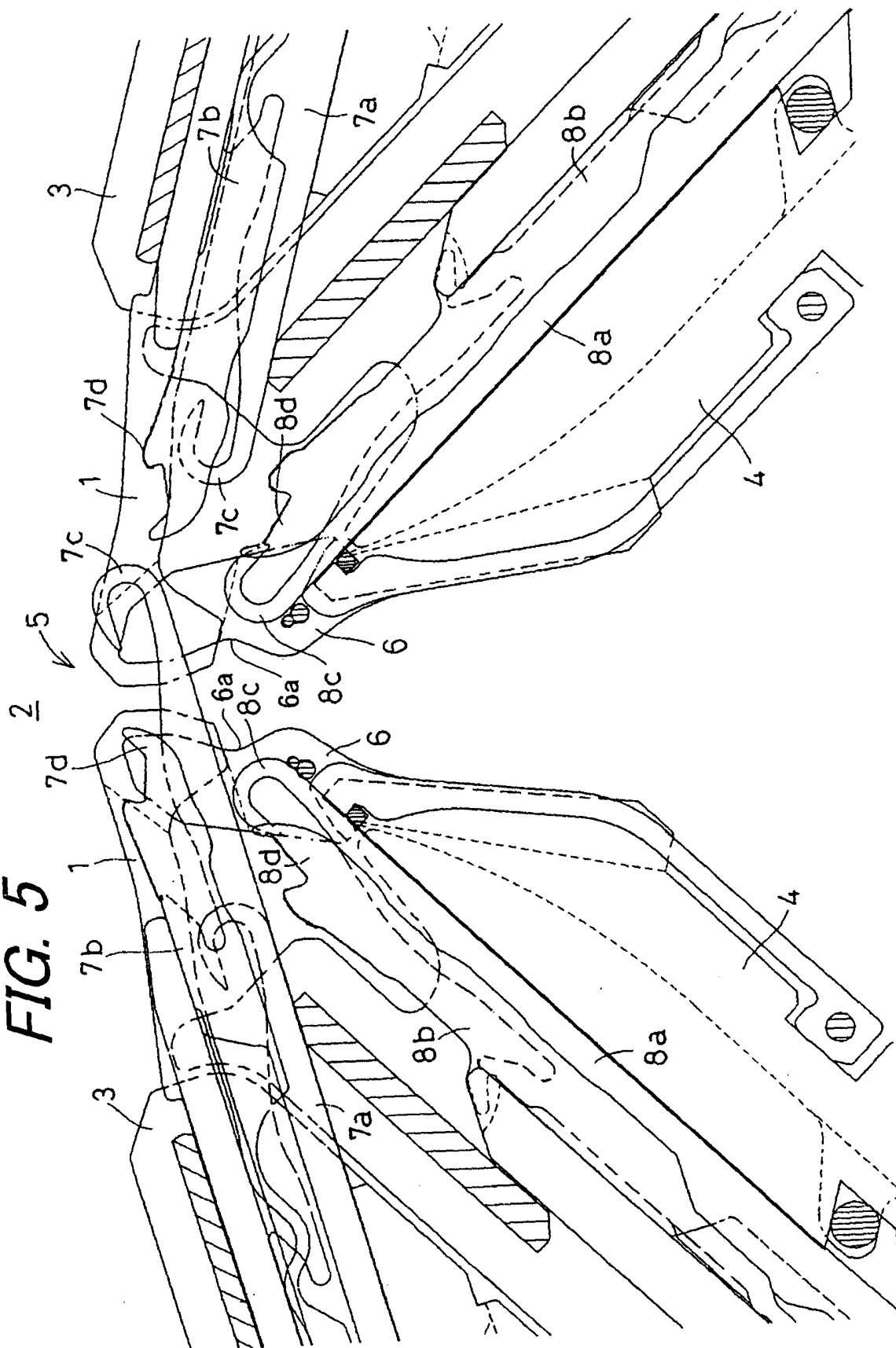


FIG. 6 5 →

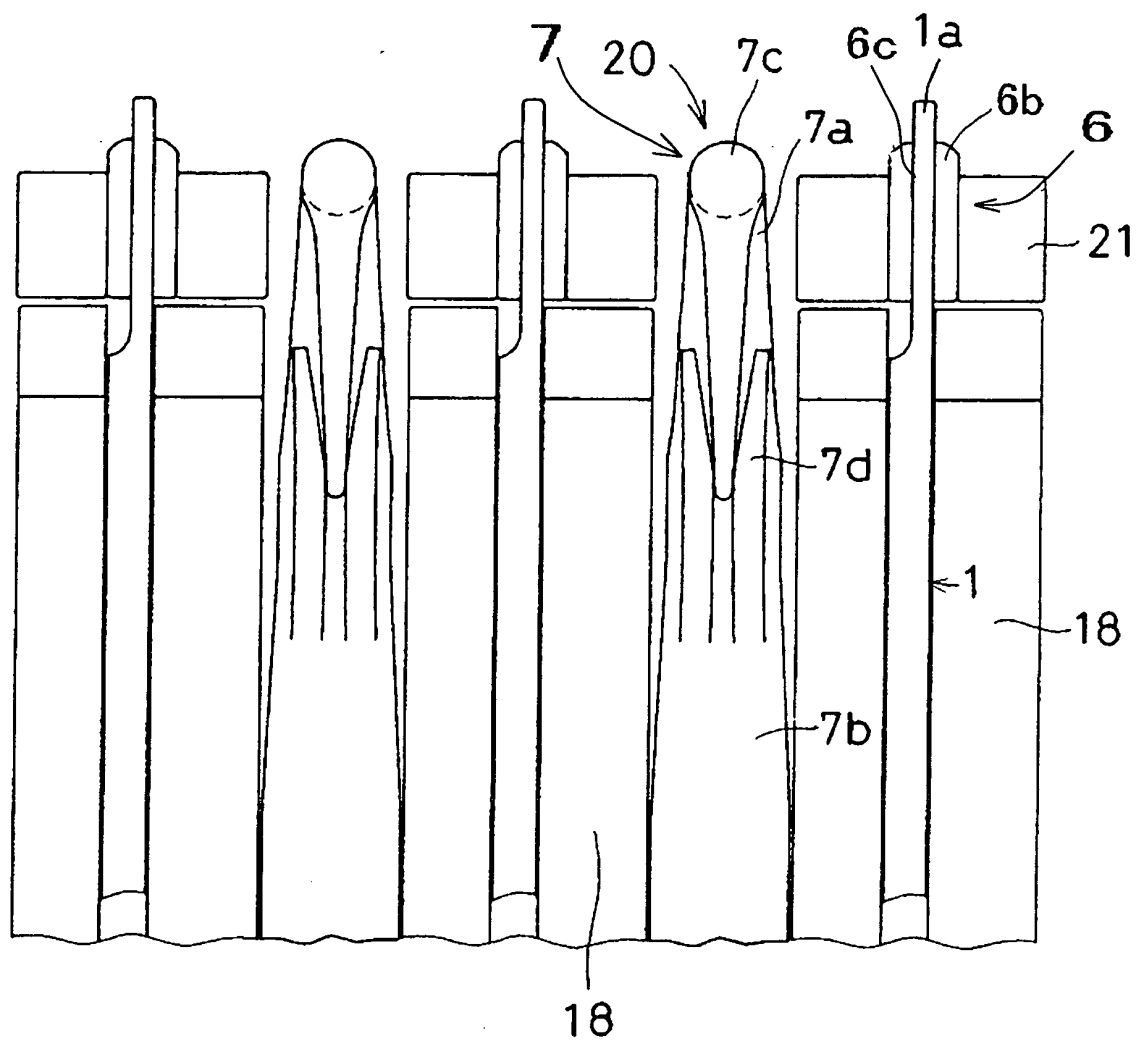
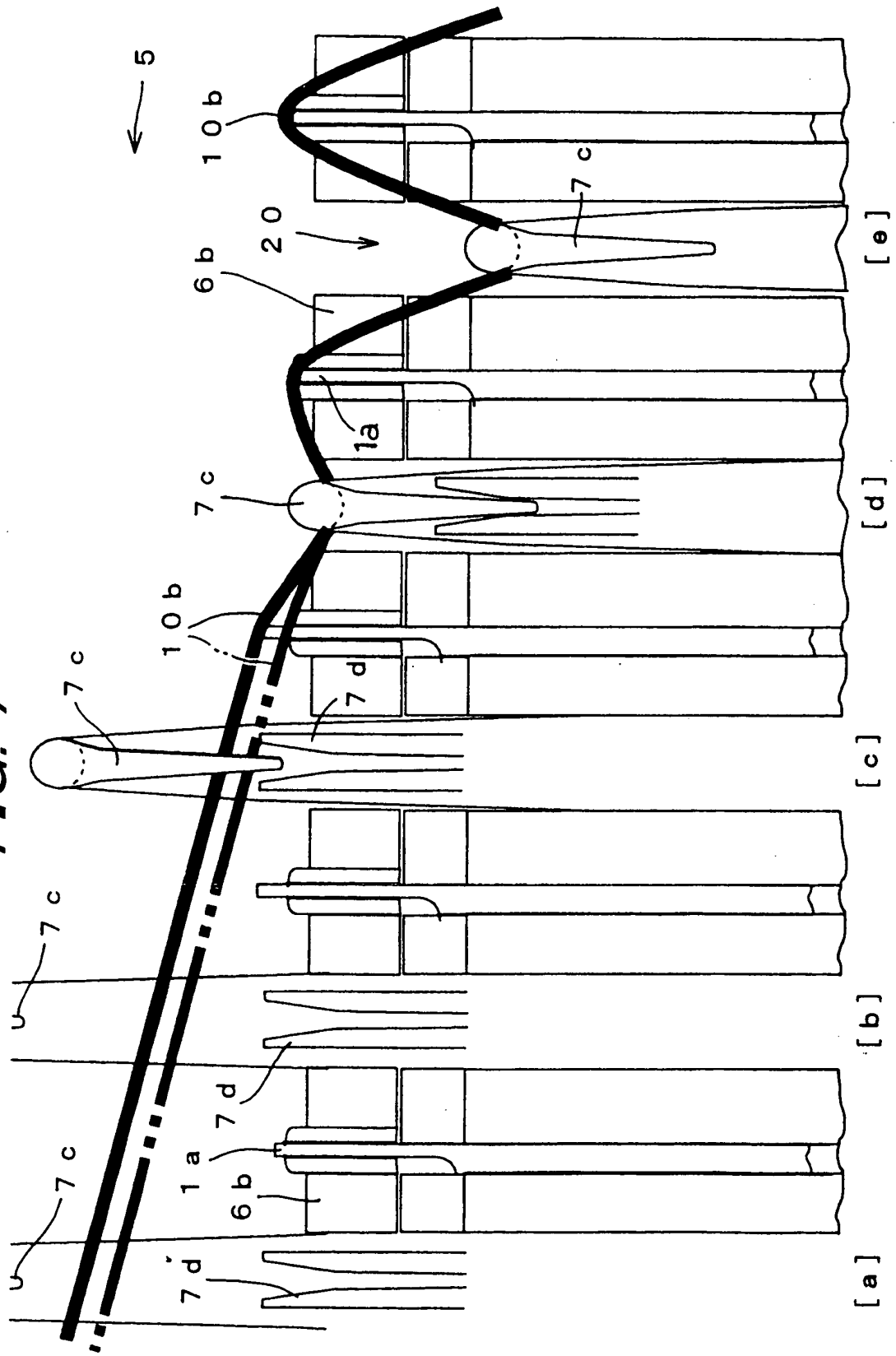


FIG. 7



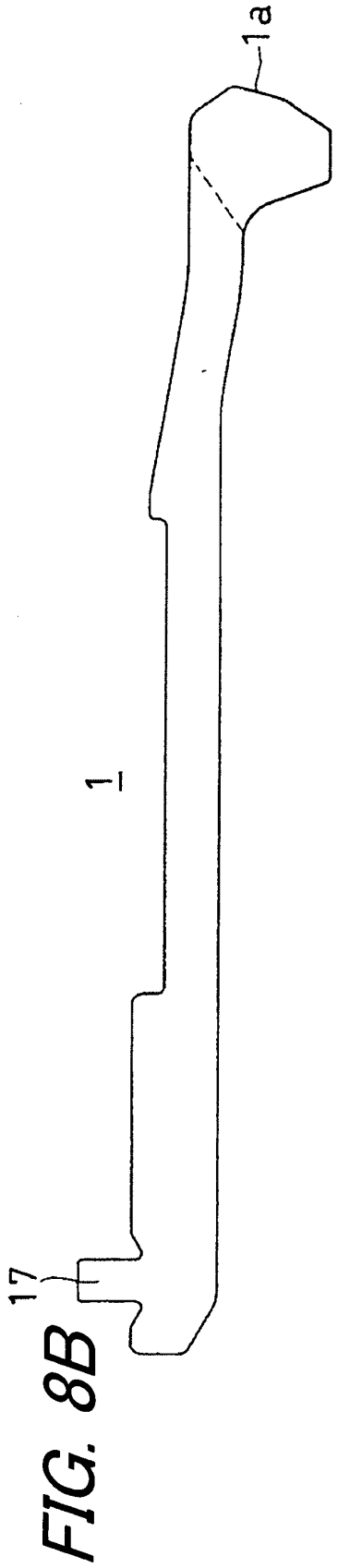
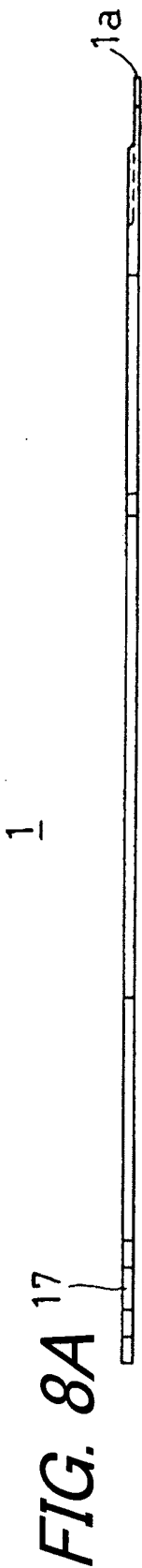


FIG. 9A

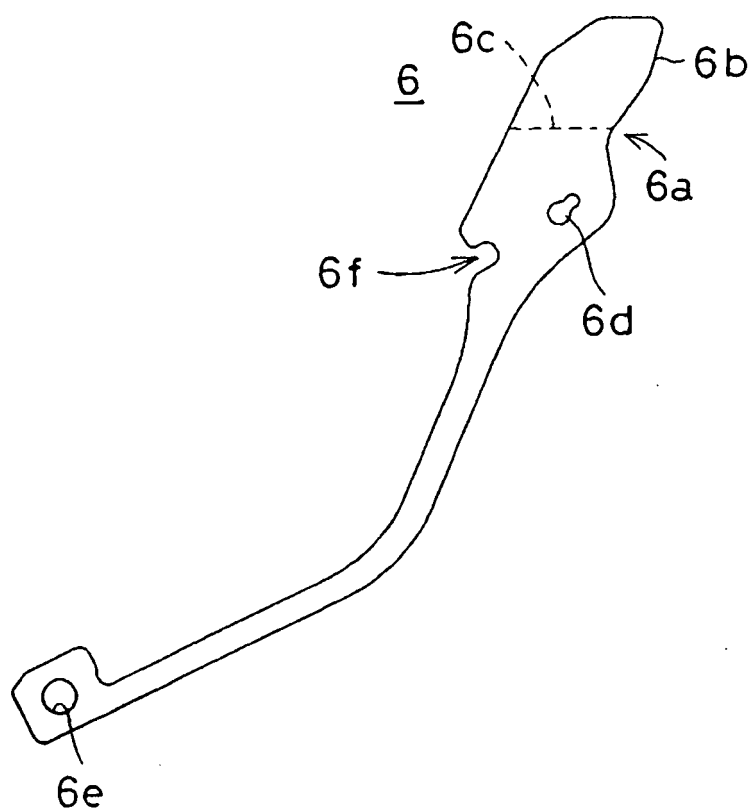


FIG. 9B

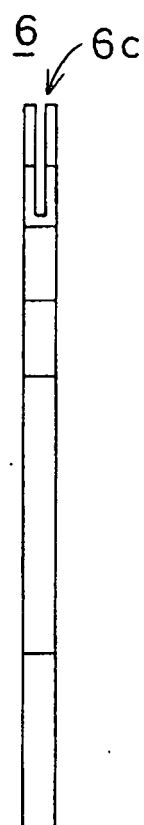


FIG. 10A

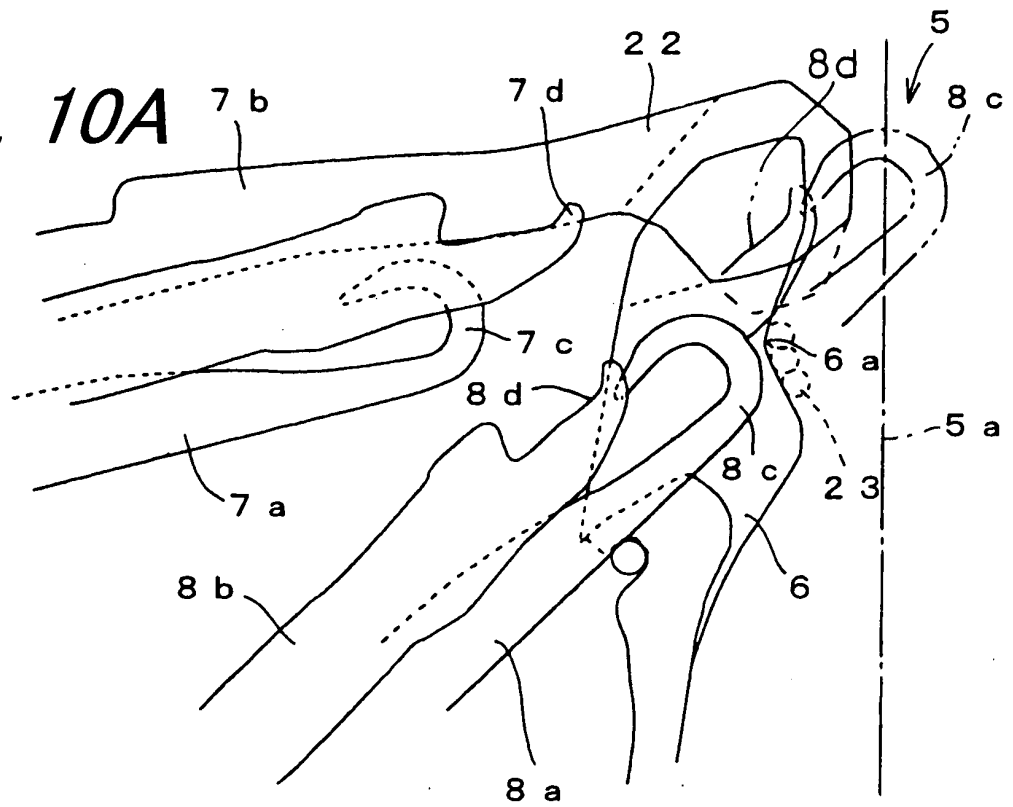


FIG. 10B

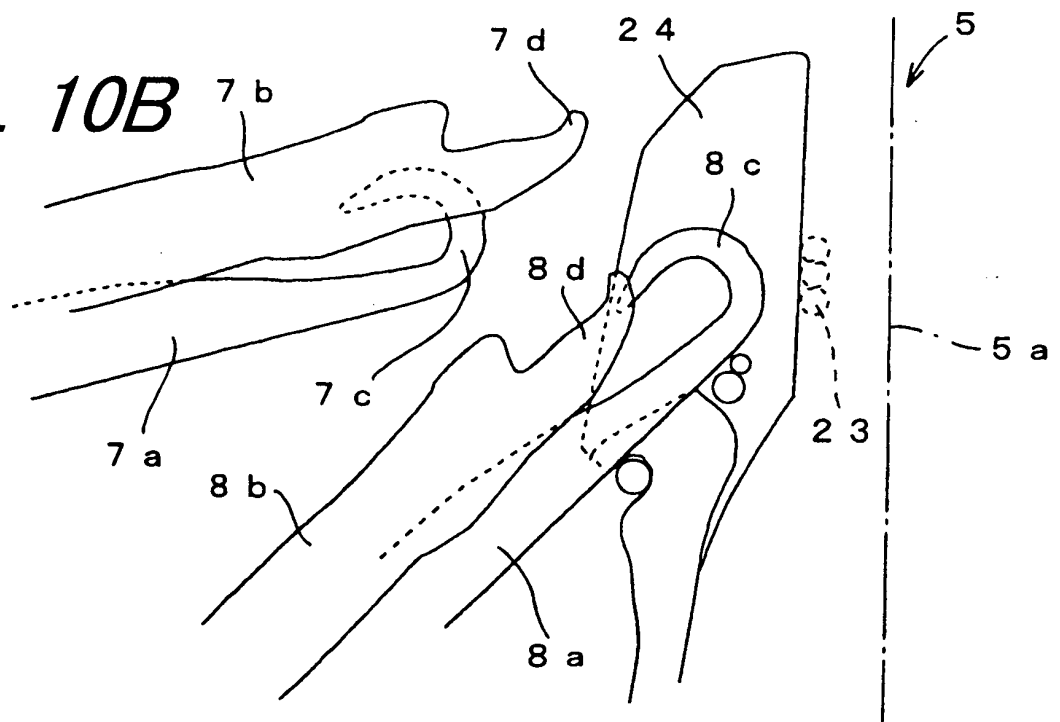


FIG. 11A

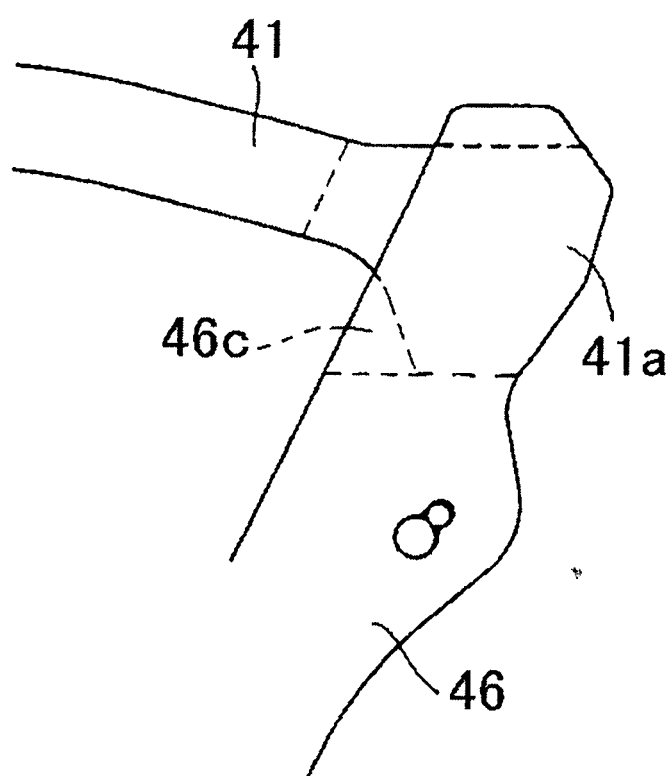


FIG. 11B

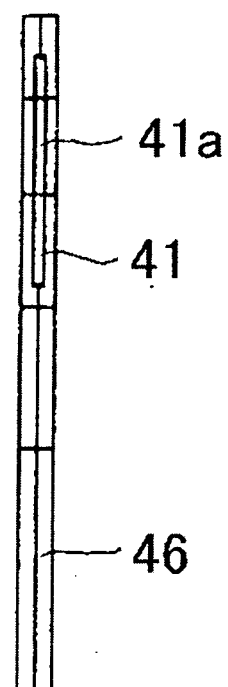


FIG. 12A

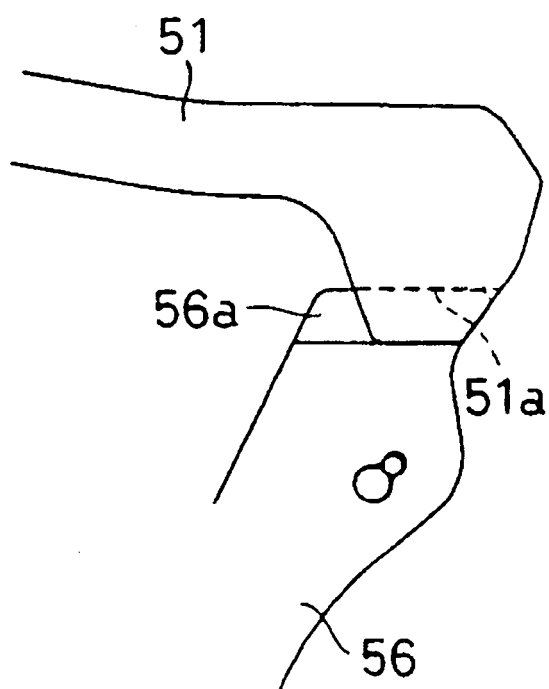


FIG. 12B

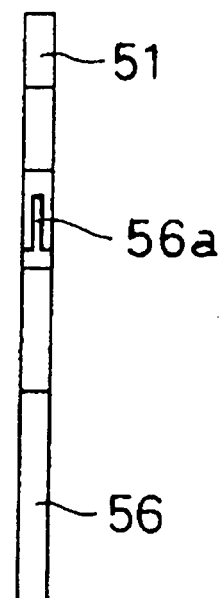


FIG. 13A

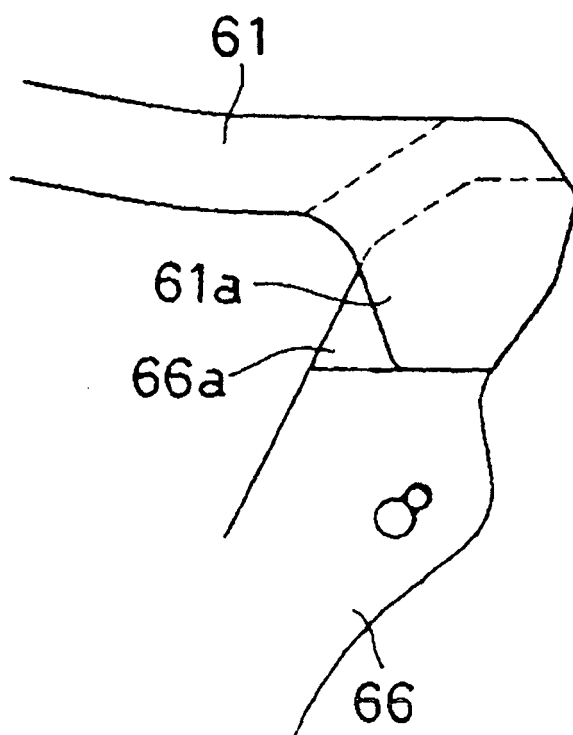


FIG. 13B

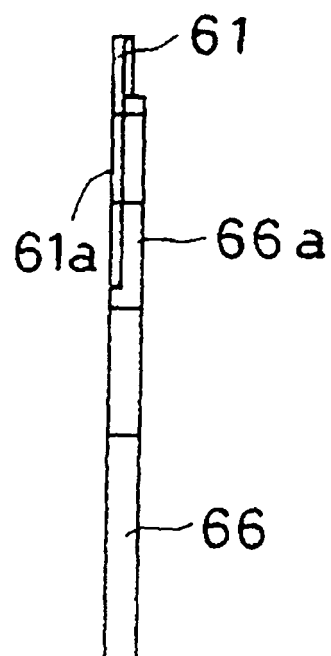


FIG. 14A

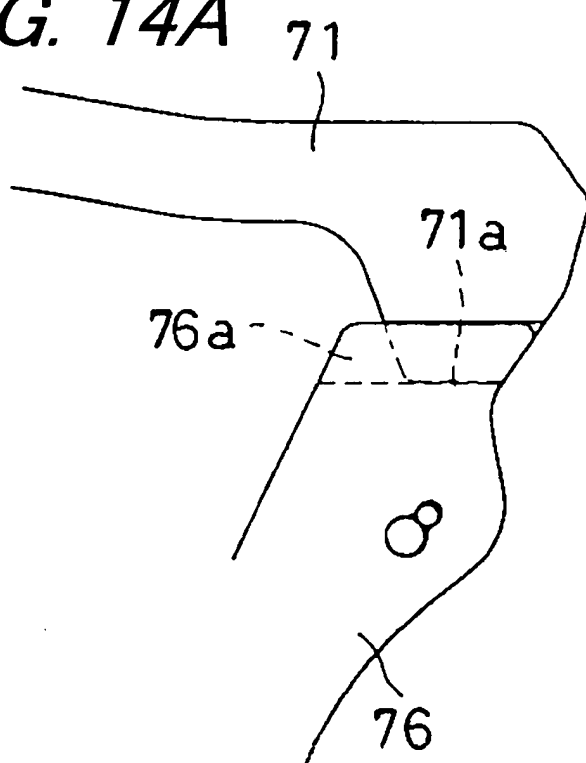
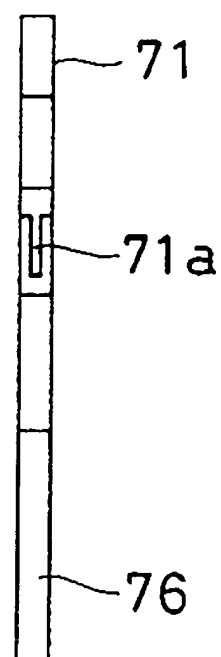


FIG. 14B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/319204

A. CLASSIFICATION OF SUBJECT MATTER

D04B15/56(2006.01) i, D04B15/06(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)

D04B15/56, D04B15/06

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 3333304 A (Shima Seiki Mfg., Ltd.), 15 October, 2002 (15.10.02), & EP 672769 A1 & DE 69502524 C	1, 3, 4 2
A	JP 7-96740 B2 (Shima Seiki Mfg., Ltd.), 18 October, 1995 (18.10.95), (Family: none)	1-4

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" 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

"&" document member of the same patent family

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

Authorized officer

Facsimile No.

Telephone No.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 3333304 B [0003] [0003] [0008] [0019] [0030] [0033]
- JP 7796740 B [0006]
- JP 7096740 B [0006]