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(72) Inventor: **ARIKITA, Reiji**
Wakayama-shi
Wakayama 641-8511 (JP)

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(74) Representative: **Wagner, Karl H.**
Wagner & Geyer Partnerschaft
Patent- und Rechtsanwälte
Gewürzmühlstrasse 5
80538 München (DE)

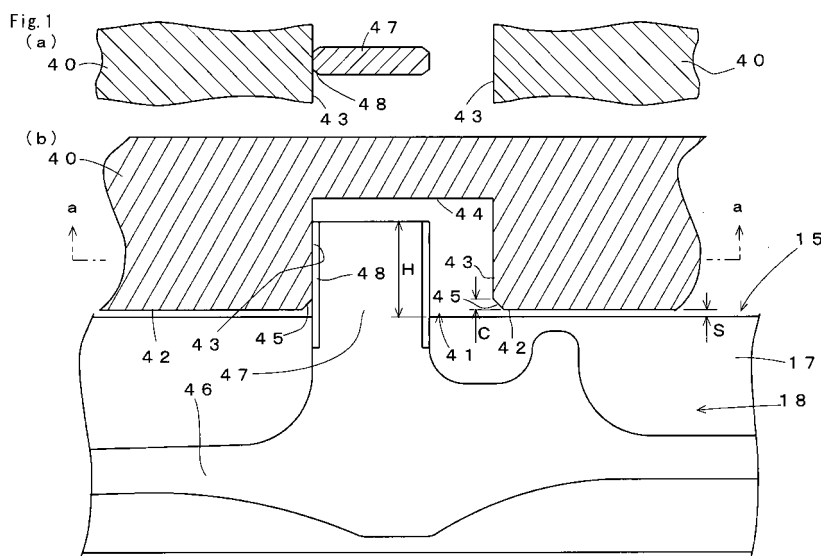
(71) Applicant: **Shima Seiki Manufacturing., Ltd.**
Wakayama 641-8511 (JP)

(54) **CAM FOR DRIVING KNITTING NEEDLE AND WEFT KNITTING MACHINE**

(57) To provide a knitting needle driving cam and a flatbed knitting machine that can prevent seizure of a knitting needle to a butt in a simple structure.

A cam member 40 for driving a knitting needle is generally plate-form and is mounted to a carriage reciprocating the surface of a needle bed 15. The cam member 40 has a groove cam 41 formed to face the surface of the needle bed 15 and having a cam wall face 43 that comes in contact with and guides a butt 48 protruding from a knitting member 46 housed in a needle groove 18

of the needle bed 15 to the outside of the needle groove 18. The groove cam 41 is provided with a chamfering 45, and the edge of the cam wall face 43 on the cam surface 42 side is removed. A butt 47 protrudes more than 2 mm from the surface of the needle bed 15. Between the surface of the needle bed 15 and the cam surface 42, a clearance S of 0.2 mm is provided. The edge is removed by the chamfering 45 in a range of 0.2 to 0.4 mm away from the cam face of the groove cam 41 to the thickness direction.



Description**Technical Field**

5 **[0001]** The present invention relates to a knitting needle driving cam, which is mounted on a carriage running along a needle bed and drives a knitting needle by guiding a butt, which protrudes from a needle groove of the needle bed, and also relates to a flatbed knitting machine.

Background Art

10 **[0002]** As is conventional, in a flatbed knitting machine, knitting needles are housed in needle grooves line upped in parallel on a needle bed, hooks on the head end side of the knitting needles are advanced and retreated relative to a needle bed gap formed on the edge side of the needle bed and knitting is performed. The drive to advance and to retreat knitting needles is done by a knitting needle driving cam mounted to a bottom board on the bottom surface side of a carriage that reciprocates in the parallel direction of the line upped needle grooves. The knitting needle driving cam is approximately in the form of a plate, and a surface formed as if it is cut nearly perpendicularly from a surface that faces the needle bed when the cam is mounted to the carriage becomes a cam face. The cam face comes in contact with a butt protruding from the knitting needle to the carriage side and drives the butt. In a cam layout plan that indicates a layout of the knitting needle driving cam on the bottom plate of the carriage, the cam face is shown as a profile line including a section tilting with respect to the carriage running direction (see Patent Citation 1 and Patent Citation 2).

15 **[0003]** Fig. 6 simplifies Fig. 5 of Patent Citation 1 and shows one example of a knitting needle 1 under the condition of being housed in a needle bed. The knitting needle 1 is a latch needle and a hook 3 on the head end of a needle body 2 is opened and closed by a latch 4. To the tail end side of the needle body 2, a needle jack 5 is linked. To one side of the needle body 2, a stitch transferring fin 6 is fixed. To the needle jack 5, a knitting operation butt 7 is provided in the vicinity of the intermediate of the whole, and a stitch transferring butt 8 is provided in the vicinity of the head end. The needle jack 5 has an elastic leg between the knitting operation butt 7 and the tail end, and the vicinity of the intermediate of the elastic leg is pressed by a head end of a select jack 9, in the head end of which a selecting butt 10 is provided. On the back side of the selecting butt 10, the head end of a selector 11 comes in contact so as to press up the needle selecting butt to the right side of Fig. 6. The selector 11 has a lowering butt 12 that lowers the needle selecting butt to the left side of Fig.6 and the raising butt 13 that raises the needle selecting butt to the right side, and has a needle selecting butt 14 at the intermediate. The needle selecting butt 14 is assigned to one of a plurality of positions for each knitting needle 1.

20 **[0004]** The knitting needle 1 is combined with the needle body 2, needle jack 5, select jack 9, and selector 11, and is supported on a needle bed 15 side. In the needle bed 15, needle plates 17 are vertically arranged with predetermined intervals on a base plate 16, and the knitting needle 1 is housed in a needle groove 18 formed between needle plates 17. The hook 3 on the head-end side of the knitting needle 1 advances to and retreats from a needle bed gap 19 by slide-displacement in the lateral direction of the drawing inside the needle groove 18 and pulls in the knitting yarn supplied on the needle bed gap 19 into the needle bed 15 side and forms a stitch. In a flatbed knitting machine with a pair of needle beds 15 provided on both of front and back sides that hold the needle bed gap 19 in-between, various knitted fabrics are knitted by the use of one or both needle beds 15 or stitch transfer for transferring stitches between needle beds 15 is possible, too.

25 **[0005]** Incidentally, each needle bed 15 is tilted so as to be higher on the needle bed gap 19 side and so as to be lower on the side departing from the needle bed gap 19, but for convenience of explanation, one needle bed 15 only is displayed in a horizontal position. In addition, the moving directions of the knitting needle 1 are described as follows: the right direction of Fig.6 in which the knitting needle 1 moves to the needle bed gap 19 side as a rising direction, the left direction of Fig.6 in which the knitting needle 1 departs away from the needle bed gap 19 as a lowering direction, and the vertical direction of Fig.6 as a rise and a fall direction, respectively. In addition, the needle plate 17 has a structure to house a sinker of a fixed type or of a movable type on the needle bed gap 19 side, but the illustration is omitted.

30 **[0006]** Fig. 7 shows a schematic structure of a cam system 20 for driving the knitting needle 1 as shown in Fig. 6 to perform knitting operation and stitch transfer operation. The cam system 20 is mounted, for example, in two sets, to a carriage that reciprocates in the direction perpendicular to the paper surface along the needle bed 15 of Fig. 6. The cam system 20 of each set includes a transfer cam for both sending and receiving 21, a fixed needle raising cam 22, a movable needle raising cam 23, stitch cams 24, a transfer guide cam 25, needle guide cams 26, selector guide cams for clearing 27, raising selector guide cams 28, and selector raising cams 29. These cams are disposed on the bottom board 30 of the carriage. The transfer cam for both sending and receiving 21 and the movable needle raising cam 23 have their protruding condition to be changed over alternately so that when one achieves the condition of protruding from the surface of the bottom board 30, the other achieves the condition of sinking into the bottom board 30.

35 **[0007]** The cam system 20 disposed on the bottom board 30 includes an action unit for needle selecting 31, such as

needle selecting actuator, etc. The action unit for needle selecting 31 works on the needle selecting butt 14 of the selector 11 of Fig. 6. In the needle selecting operation, action of the selector guide cam for clearing 27 with respect to the lowering butt 12 of the selector 11, and operations of selector guide cam for raising 28 and selector raising cam 29 with respect to the raising butt 13, are involved, too. In the needle selecting operation, routes of the selecting butt 10 of the selector jack 9 are changed over. To the route of the selecting butt 10, a presser 32 is disposed.

[0008] Patent Citation 2, etc. discloses flatbed knitting machines having a compound needle that opens and closes a hook by a slider that slides with respect to the needle body as a knitting needle instead of a latch needle. In knitting needles of a flatbed knitting machine, irrespective of needle types, such as latch needles or compound needles, the knitting needles advance to and retreat from the needle bed gap 19 by a cam to guide the knitting butt 7 or the stitch transferring butt 8 provided on the needle jack 5 linked to the needle body 2. When knitted stitches are formed such as knit, the knitting butt 7 is guided in such a manner that the knitting butt 7 passes through a groove cam 37 formed as a groove-form route whose top and bottom are held by the movable needle raising cam 23 with its cam faces. For a sending needle at the time of stitch transfer, the stitch transferring butt 8 is guided in such a manner that the stitch transferring butt 8 passes through a groove cam 38 formed between the top edge of the transfer cam for both sending and receiving 21 and the bottom edge of the stitch transfer guide cam 25. The groove cams 37, 38 that guide a single butt are formed in such a manner that the groove width is slightly wider than the width of the knitting butt 7 or the stitch transferring butt 8. For a receiving needle at the time of stitch transfer, the knitting butt 7 is guided in such a manner that the top edge 39a formed inside the fixed needle raising cam 22 serves as a cam face and pushes up the knitting butt 7, and the stitch transferring butt 8 is guided in such a manner that the bottom edge 39b of the transfer cam for both sending and receiving 21 serves as a cam face and pushes down the stitch transferring butt 8. These cam faces are wall faces formed as if they are cut by a sharp edge from the surface of the plate-like member to the thickness direction, and they are indicated by profile lines on the cam layout drawing. In a zone where the guiding route of the groove cam is tilted with respect to the carriage running direction, a cam face on the lower side mainly guides the butt when the butt is rising and a cam face on the upper side mainly guides the butt when the butt lowering.

[0009] In addition, when the presser 32 presses the selecting butt 10 from upside of Fig. 6, the head end of the select jack 9 presses the needle jack 5 and sinks the knitting butt 7 in the needle groove 18. Consequently, even if the knitting butt 7 is guided by the groove cam 37, changing over to the route where the selecting butt 10 is pressed by the presser 32 allows the knitting butt 7 to escape from the groove cam 37 and enables change-over operations from the knit to the tuck and the like.

Patent Citation 1 : International Publication No. WO 07/074944 Pamphlet (Fig. 1 and Fig. 6)

Patent Citation 2 : Japanese Examined Patent Publication No. 2917146 (Fig. 1 and Fig. 33)

Disclosure of the Invention

Technical Problem

[0010] Since the knitting operation butt 7 and the stitch transferring butt 8 which are guided by groove cams 37, 38 of Fig. 7 or the top edge 39a inside the fixed needle raising cam 21 or the bottom edge 39b of the transfer cam for both sending and receiving 21 are subject to the operation from the cam face on one side, the force is applied to the direction in which the butts are tilted. In addition, when the butts begin to rise or begin to lower, the butts collide when the butts come in contact with the cam faces from the condition in which the butts are separated from groove cams 37, 38 or cam faces of the top edge 39a or bottom edge 39b. Under these occasions of collision, force is also applied to the direction in which butts are tilted. In order to increase the productivity in a flatbed knitting machine, the knitting speed must be increased. In particular, when knitting is performed at a high speed, the edge of the head end of the cam face cuts into the falling butt, and a seizure may occur.

[0011] Even if the cam face is lubricated in order to prevent seizure, when a plurality of butts pass through, the cam face runs short of oil and a seizure may result. Reducing the cam face angle tilting with respect to the carriage running direction may be able to reduce the force to tilt the butt and may be able to suppress seizure occurrence, but the cam and the carriage are enlarging. When the carriage becomes large, the running stroke necessary to knit the fabric of the same knitting width increases so that it becomes a trouble that raises the productivity.

[0012] It is an object of the present invention to provide a knitting needle driving cam and a flatbed knitting machine that can prevent seizure of a knitting needle to a butt in a simple structure.

Technical Solution

[0013] The present invention relates to a knitting needle driving cam, which is used by being mounted to a bottom board of a carriage reciprocating along a needle bed of a flatbed knitting machine, is approximately plate-form, and has

a cam face to come in contact with a butt protruding from a knitting needle housed in a needle groove of the needle bed, the knitting needle driving cam being formed as if it is cut into a thickness direction from the plate-form surface, wherein a zone, where the cam face tilts with respect to the carriage running direction in such a manner that the cam drives a knitting needle to advance to and retreat from the needle bed gap, includes a range with a corner edge of a cross-section removed at a portion where the surface changes from the plate-form surface to the cam face.

[0014] In addition, in the present invention, said butt, with which said cam face comes in contact, protrudes more than 2 mm from the top edge of the needle groove,

a clearance of 0.2mm is provided between the plate-form surface and the top edge of the needle groove when the cam is mounted to said carriage, and

said range, in which the corner edge is removed, falls in a section of 0.2 to 0.4 mm away from the plate-form surface.

[0015] In addition, in the present invention, said edge is removed in a range in which the angle of the cam face tilting with respect to the carriage running direction is not less than 45 degrees.

[0016] Furthermore, the present invention relates to a flatbed knitting machine, comprising:

a knitting needle driving cam described in above; and
a carriage mounted with the cam.

Advantageous Effects

[0017] According to the present invention, a knitting needle driving cam is mounted to a bottom board of a carriage reciprocating along the surface of a needle bed. To the knitting needle driving cam, a cam face, which is driven by colliding with a butt protruding from a knitting needle housed in a needle groove of the needle bed, is formed as if it is cut into the thickness direction from the plate-form surface. Since the zone where the cam face is formed includes a range with a corner edge of a portion changing from the plate-shape surface to the cam face removed, even if the butt falls during high-speed knitting, the head end of the cam face is difficult to be cut in. In addition, a lubricant is easy to be held between the cam face and the butt. In this way, the knitting needle driving cam of a flatbed knitting machine according to the present invention can prevent seizure of a knitting needle to the butt in a simple structure of removing the cam face edge.

[0018] In addition, according to the present invention, the butt, which comes in contact with the cam face so as to be guided, protrudes more than 2 mm from the top edge of the needle groove, a clearance of 0.2 mm is provided between the top edge of the needle groove and the surface of the knitting needle driving cam, and the edge is removed in a range from 0.2 to 0.4 mm away from the groove cam face. Since the range, in which the edge removed on the cam face, remains on the root side of the butt protruding from the top edge of the needle groove, a sufficient latching margin is able to be secured without increasing the moment for the cam face to turn over the butt, with which the cam face comes in contact.

[0019] In addition, according to the present invention, since the edge is removed in a range in which the angle of the cam face tilting with respect to the carriage running direction is not less than 45 degrees, seizure to the butt is able to be prevented even when the butt driven by a steeply tilted cam face.

[0020] Furthermore, according to the present invention, it is possible to prevent seizure of a knitting needle to a butt even when allowing a carriage run at a high speed, so that productivity of knitting can be increased.

Brief Description of Drawings

[0021]

[Fig. 1] Fig. 1 is a simplified cross-sectional view showing a structure of a primary portion of a cam member 40 according to one embodiment of the present invention.

[Fig. 2] Fig. 2 is a partial cam layout drawing showing a structure of a cam system 50 to which the concept of the cam member 40 of Fig. 1 is applied to a cam system 20 of Fig. 7.

[Fig. 3] Fig. 3 is a cross-sectional view schematically showing the effect of providing a chamfering 45 to the side of a cam surface 42 of a cam wall face 43 of a groove cam 41 of the cam member 40 of Fig. 1.

[Fig. 4] Fig. 4 is a cross-sectional view showing a structure to perform edge removal at a portion where cam walls 73, 83 are cut from cam wall faces 72, 82 of other cam members 70, 80 together with chamfering 45 at the cam member 40 of Fig. 1.

[Fig. 5] Fig. 5 is a cross-sectional view showing the effect of oil shortage prevention by providing the chamfering 45 to the cam member 40 of Fig. 1 in comparison with a conventional cam member 60 in which no chamfering is provided.

[Fig. 6] Fig. 6 is a side view showing a conventional structure of knitting needle 1.

[Fig. 7] Fig. 7 is a cam layout drawing showing a general structure of a cam system 20 that drives the knitting needle

1 of Fig. 6 to perform knitting operation and stitch transfer operation.

Explanation of Reference

5	[0022]	
	1	Knitting needle
	2	Needle body
10	5	Needle Jack
	7	Knitting operation butt
15	8	Stitch transferring butt
	15	Needle bed
	17	Needle plate
20	18	Needle groove
	19	Needle bed gap
25	40, 70, 80	Cam member
	41, 57, 58	Groove cam
	42	Cam face
30	43	Cam wall face
	45, 51a, 53a, 53b, 55a, 75, 85	Chamfering
35	46	Knitting member
	47	Butt
	50	Cam system
40	51	Transfer cam for both sending and receiving
	51 b, 51 c, 52a, 57a, 57b, 58a, 58b	Tilted section
45	52	Fixed needle raising cam
	53	Movable needle raising cam
	54	Stitch cam
50	55	Transfer guide cam
	59a	Top edge
55	50b	Bottom edge

Best Mode for Carrying Out the Invention

[0023] Fig. 1 (a) and Fig. 1 (b) show a primary portion of the cam member 40, one of the embodiments of the present invention, as a simplified cross-sectional structure. In particular, Fig. 1 (a) shows a cross-sectional view taken from a cutting-plate line a-a in Fig. 1 (b). Incidentally, in the following description, portions that correspond to portions described in advance are given the same reference characters and redundant description may be omitted.

[0024] The cam member 40 has a groove cam 41, for example, as in the case of the movable needle raising cam 23 which is used for the cam system 20 of Fig. 7 and has the groove cam 37. The cam member 40 has generally a plate-like form and is mounted to a bottom board on the bottom side of a carriage of a flatbed knitting machine. When the cam member 40 is mounted on the carriage, its cam surface 42 is opposed to the needle bed 15 surface with a clearance S provided. The clearance S is, for example, 0.2 mm. The groove cam 41 has the cam wall face 43 as the cam face, which is formed in the thickness direction by cutting the cam member 40 perpendicularly from the cam surface 42. In the event that the groove cam 41 is formed in a single cam member, the groove cam 41 has a cam bottom surface 44. The groove cam 41 is not limited to that provided in the single cam member 40 but may be a groove cam 38 between the top edge of the stitch transfer cam for both sending and receiving 21 and the bottom edge of the stitch transfer guide cam 25 of Fig. 7, or a cam having the top edge 39a formed inside the fixed needle raising cam 22 and the bottom edge 39b of the stitch transfer cam for both sending and receiving 21 as cam wall faces 43. In such event, the bottom board 30 corresponds to the cam bottom surface 44. In the groove cam 41, the edge on the cam surface 42 side of the cam wall face 43 is removed by providing chamfering 45 of a tilted surface that makes an angle of, for example, 45 degrees.

[0025] The edge removal by the chamfering 45 is performed in a range C which is 0.2 to 0.4 mm away from the cam surface 42 of the groove cam 41 in thickness direction of the cam member 40. The groove cam 41 guides a butt 47 of a knitting member 46, such as the needle jack 5 in Fig. 6. The knitting member 46 protrudes with a protrusion allowance H from the top edge of the needle groove 18, which serves as the surface of the needle bed 15, in the condition in which the knitting member 46 is floating inside the needle groove 18. Incidentally, the top edge of the needle groove 18 should be formed by the top edge of the needle plate 17. The protrusion allowance H is about 2 to 3 mm. The range for removing the edge by the chamfering 45 on the cam wall face 43 which serves as the cam face remains on the root side of the butt 47 protruding from the top edge of the needle groove 18, and therefore, a sufficient latch margin is able to be secured without increasing the moment at which the cam wall face 43 comes in contact with the butt 47 to turn over it.

[0026] In Fig. 1, the carriage runs in the direction perpendicular to the paper surface and the cam member 40, mounted to the carriage, also moves. In Fig. 1 (a), the cam wall face 43 which serves as the cam face of the groove cam 41 is shown as if the cam wall face 43 is parallel to the running direction and is not tilted, but in the portion that drives the knitting member 46 to slide right and left of the figure in the needle groove 18, that is, in the direction in which the knitting member 46 advances and retreats with respect to the needle bed gap, the cam wall face 43 must be tilted with respect to the running direction. Even if the cam wall face 43 shown in Fig. 1(a) is tilted with respect to the running direction, chamfering 48 is provided on the cross-sectional side of the butt 47 and the portion that serves as an edge with respect to the tilted cam face is removed so that the butt 47 is able to be guided smoothly.

[0027] Fig. 2 shows a structure of a primary portion of a cam system 50 formed by applying the concept of the groove cam 41 in the cam member 40 of Fig. 1 to the cam system 20 of Fig. 7. The Cam system 50 includes a stitch transfer cam for both sending and receiving 51, a fixed needle raising cam 52, a movable needle raising cam 53, stitch cams 54, a transfer guide cam 55, and needle guide cams 56. Other structure is same as that of Fig. 7. In the stitch transfer cam for both sending and receiving 51, the fixed needle raising cam 52, the movable needle raising cam 53, and the stitch transfer guide cam 55, respective cam faces in the thickness direction perpendicular to the surface are formed at the groove cams 57, 58, top edge 59a and bottom edge 59b which correspond to the groove cams 37, 38, top edge 39a and bottom edge 39b. A carriage to which the cam system 50 is mounted runs right and left of the figure, and therefore, tilted cam faces used for driving a butt when the carriage is running in each of right and left directions are disposed in a state of line symmetry. The cam faces including the tilted section and continuing each other in a state of line symmetry, are removed edges by forming chamfering 53a, 53b; 55a, 51 a same as the chamfering 45 as in the case of the cam surface 42 side of the cam member 40 of Fig. 1. In addition, to the top edge 59a inside the fixed needle raising cam 52 and the bottom edge 59b of the stitch transfer cam for both sending and receiving 51, chamfering is provided to the whole.

[0028] The cam faces on both sides of groove cams 57, 58 to which chamfering 53a, 53b; 55a, 51 a is provided must have the cam face working on the knitting operation butt 7 or stitch transferring butt 8 changed over in accordance with the right and left running directions of the carriage in the figure. Since the carriage is reciprocated, both cam faces used for the round trip in the tilted section must be chamfered. For example, the upper cam face of the groove 57 to which the chamfering 53a is provided includes a tilted section 57a which makes an angle of about 53 degrees with respect to the carriage running direction. The lower cam face of the groove 57 to which the chamfering 53b is provided includes a tilted section 57b which makes an angle of about 53 degrees with respect to the carriage running direction. The cam faces on the upper side and the lower side of the groove cam 58 to which chamfering 55a, 51 a is provided include tilted sections 58a, 58b, respectively, which make an angle of about 53 degrees with respect to the running direction. Fur-

thermore, the top edge 59a formed inside the fixed needle raising cam 52 includes a tilted section 52a which makes an angle of about 50 degrees with respect to the running direction, too. The bottom edge 59b of the stitch transfer cam for both sending and receiving 51 which is chamfered all over includes tilted sections 51 b, 51 c which make an angle of about 50 degrees and about 45 degrees respectively with respect to the running direction. By providing chamfering at least to the tilted sections 57a, 57b, 58a, 58b, 52a, 51 b, 51 c which tilt no less than 45 degrees with respect to these running directions, seizure can be prevented. Even in a horizontal portion that connects these sections, continuous chamfering is provided for the convenience of processing. Furthermore, to the tilted cam face which pulls in the knitting needle by a stitch cam 54, a chamfering 54a same as the chamfering 54 of Fig. 1 is also provided and seizure can be prevented.

[0029] Guiding the knitting butt 7 by the groove cam 57 of the movable needle raising cam 53 in the protruded state draws a trajectory 7a between cam faces to which chamfering 53a, 53b is provided. Since the transfer cam for both sending and receiving 51 comes into the sinking state, the stitch transferring butt 8 draws a trajectory 8a. This kind of operation corresponds to the knit and the stitch cam 54 also guides the knitting butt 7. Guiding the stitch transferring butt 8 by the groove cam 58 between the top edge of the transfer cam both sending and receiving 51 under the protruded state and the bottom edge of the stitch transfer guide cam 55 draws a trajectory 8b between cam faces to which chamfering 55a, 51a is provided. The movable needle raising cam 53 enters the sinking state, and therefore, the knitting butt 7 draws a trajectory 7b. This kind of operation corresponds to the sending needle. The operation of the receiving needle is performed in the combined sections, in one section the top edge 59a formed inside the fixed needle raising cam 52 is used as a cam face to guide the knitting butt 7, and in the other section stitch transferring butt 8 is guided along the bottom edge 59b of the transfer cam for both sending and receiving 51, so that the knitting butt 7 and the stitch transferring butt 8 draw a trajectory 7c and a trajectory 8c, respectively.

[0030] Fig. 3 schematically shows effects of providing a chamfering 45 to the cam surface 42 side of the cam wall face 43 of the groove cam 41 in the cam member 40 of Fig. 1. As shown on the left side of Fig. 3, when the cam wall face 43 comes in contact with a butt 47 and guides it, the edge 45a of the contacted section is an obtuse angle which is larger than 90 degrees, and therefore, even if the butt 47 slightly tilts and slants, the butt 47 is made difficult to cut into the cam wall face. In a conventional cam member 60, as shown in the right side of Fig. 3, a cam wall face 63 formed by being cut from a cam face 62 of a groove cam 61 becomes a sharp edge 65 in which the boundary with the cam face 62 makes an angle of about 90 degrees. The edge 65 is alleviated by polishing such as barrel finishing, but is in the area polished sufficiently so as to be smaller than 0.2 mm. In the cam member 40, providing a chamfering 45 to an area not less than 0.2 mm makes it difficult to give damage such as a scratch to the butt 47. Incidentally, by setting the upper limit of the chamfering 45 to 0.4 mm, the position in which the edge 45a comes in contact with the butt 47 is able to be kept not so much apart from the surface of the needle bed 17. This can prevent the moment for overturning the butt 47 from being increased and can maintain the latch margin that serves as a range practically works on the butt 47 as a cam.

[0031] Fig. 4 shows a cross-sectional structure of other chamfering that performs edge removal at a portion where cam wall faces 73, 83 are cut from cam faces 72, 82 of cam members 70, 80 in the center drawing and in the right side drawing on equal terms with the chamfering 45 in the cam member 40 shown on the left side drawing. In the cam member 70, the edge is removed by a chamfering 75 of a curved surface shape. The chamfering 75 of a curved surface shape is able to make it difficult to generate overcutting at the contacting edge than, for example, the chamfering 45 of a tilted surface form in the cam member 40 of Fig. 3. A chamfering 85 of the cam member 80 shown on the right side of Fig. 4 is formed in a stepped form by combining a chamfering 86 of a tilted surface same as the chamfering 45 of the cam member 40 with the intermediate groove 87. The chamfering 85 provided with this kind of groove 87 increases particularly a space for storing the lubricant, and is effective for preventing oil from running out, which is discussed as follows.

[0032] Fig. 5 shows the effect of preventing oil from running out by providing the chamfering 45 to the cam member 40 in comparison with the conventional cam member 60 to which no chamfering is provided. Chamfering 75, 85 of cam members 70, 80 of Fig. 4 basically might have the similar effect, but in the following description, the effect is shown by allowing the chamfering 45 of the cam member 40 to represent.

[0033] When the butt 47 is brought to slide in contact with and guided to the surface on which an oil film 91 is formed by lubricating the cam face with a lubricant from a lubricator 90 simplistically shown by an arrow mark, the oil film 91 is temporarily removed at the portion which comes in contact with the butt 47. When the chamfering 45 is provided, the chamfering 45 serves as a space for storing the lubricant and accumulated oil 92 is generated, and at least part of the oil film 91 removed from the accumulated oil 92 is recovered, and therefore, it is assumed that the oil film 91 may be easy to be restored. As against this, when the oil film 91 is temporarily removed in the cam member 60 with no chamfering, the oil film 91 is restored from the lubricator 90 side only. Consequently, it takes time to restore the oil film 91 and when a plurality of butts 47 are continuously guided, seizure of the edge to the butt 47 may occur. Furthermore, when the butt 47 is tilted as shown in Fig. 3, even if the oil film 91 is temporarily removed by sliding in contact with the butt 47 in the vicinity of the edge 45a of the cam member 40, the lubricant accumulates in the vicinity of the chamfering 45 and the oil film 91 is likely to be recovered after the butt 47 passes through.

[0034] As described above, by a simple structure to provide a chamfering 45 on the cam surface 42 side of the cam

wall face 43 of the groove cam 41 that guides the butt 47 of the knitting member 46, seizure can be prevented even when the knitting speed increased. The cam face to which the chamfering 45 is provided must not always be both sides of the groove cam 41, but may be only one side as in the case of the chamfering 51 b on the bottom edge side of the transfer cam for both sending and receiving 51 of Fig. 2 or the chamfering 52a on the top edge side of the fixed needle raising cam 52. In addition, the chamfering 54a may be provided on the tilted cam face of the stitch cam 54.

Claims

1. A knitting needle driving cam, which is used by being mounted to a bottom board of a carriage reciprocating along a needle bed of a flatbed knitting machine, is approximately plate-form, and has a cam face to come in contact with a butt protruding from a knitting needle housed in a needle groove of the needle bed, the knitting needle driving cam being formed as if it is cut into a thickness direction from the plate-form surface, wherein a zone, where the cam face tilts with respect to the carriage running direction in such a manner that the cam drives a knitting needle to advance to and retreat from the needle bed gap, includes a range with a corner edge of a cross-section removed at a portion where the surface changes from the plate-form surface to the cam face.
2. The knitting needle driving cam according to claim 1, wherein said butt, with which said cam face comes in contact, protrudes more than 2 mm from the top edge of the needle groove, a clearance of 0.2mm is provided between the plate-form surface and the top edge of the needle groove when the cam is mounted to said carriage, and said range, in which the corner edge is removed, falls in a section of 0.2 to 0.4 mm away from the plate-form surface.
3. The knitting needle driving cam according to claims 1 or 2, wherein said edge is removed in a range in which the angle of the cam face tilting with respect to the carriage running direction is not less than 45 degrees.
4. A flatbed knitting machine, comprising:
 - a knitting needle driving cam described in any one of claims 1-3; and
 - a carriage mounted with the cam.

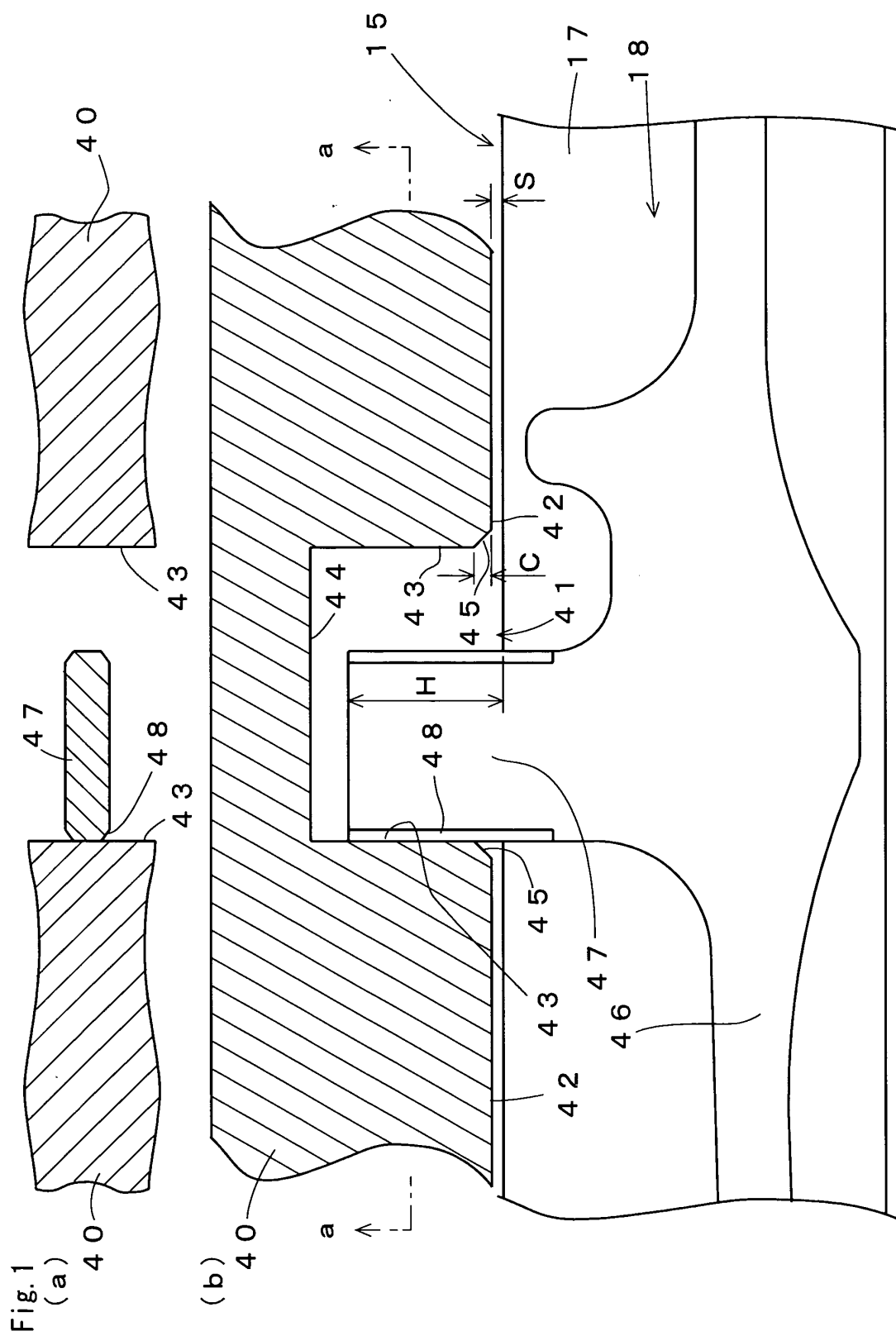


Fig. 2

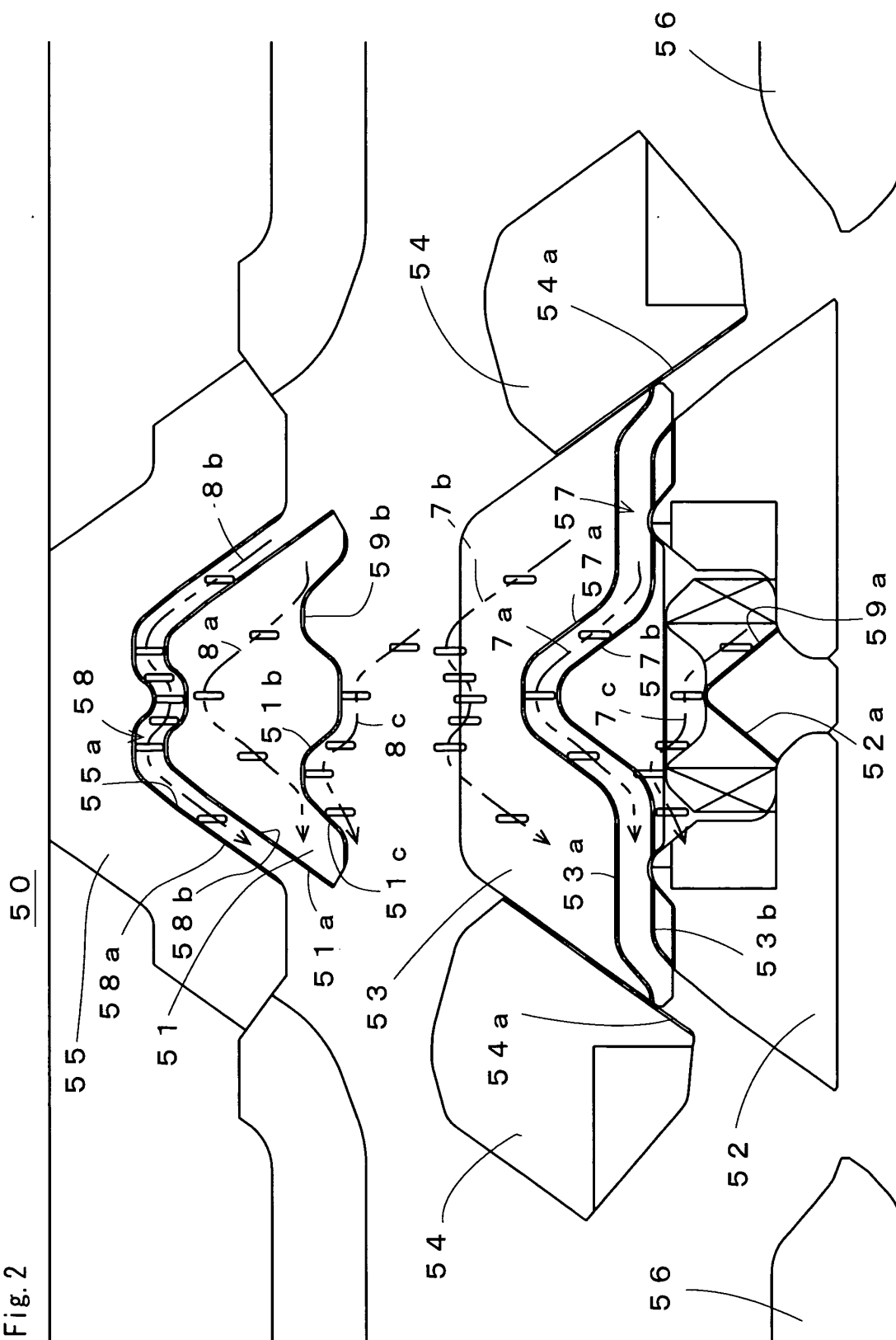


Fig. 3

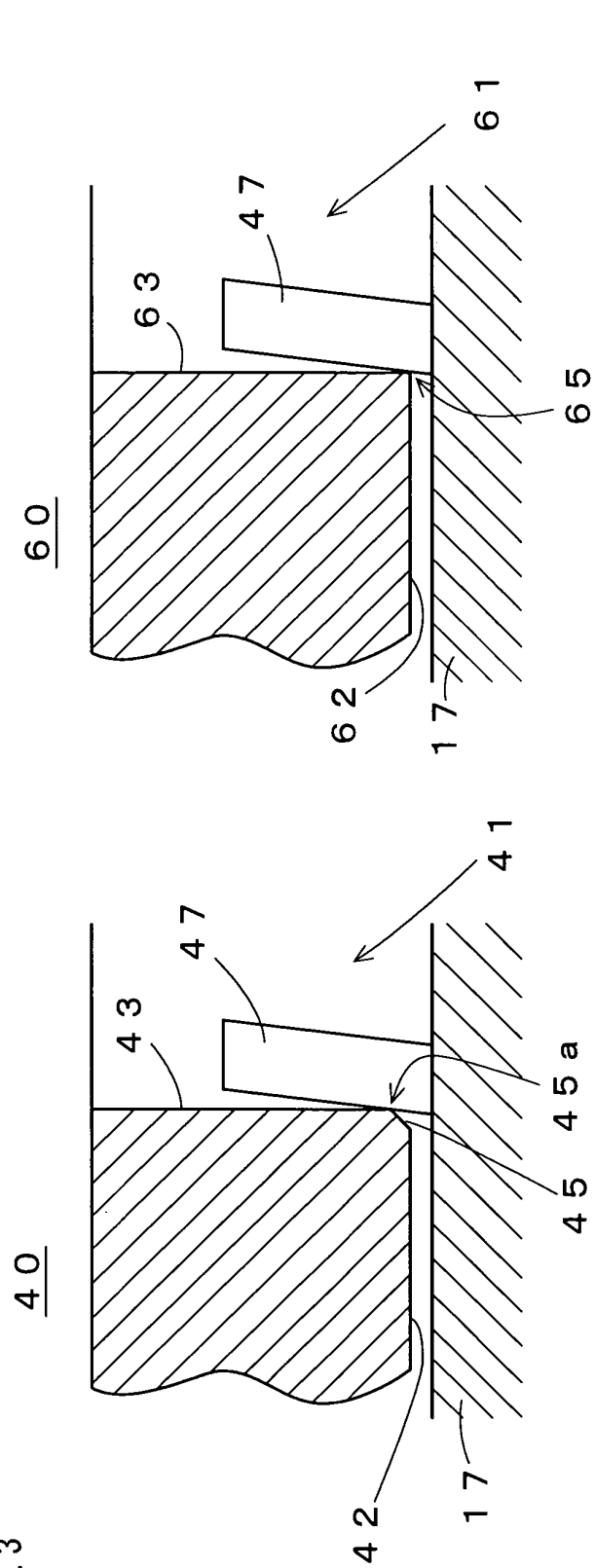
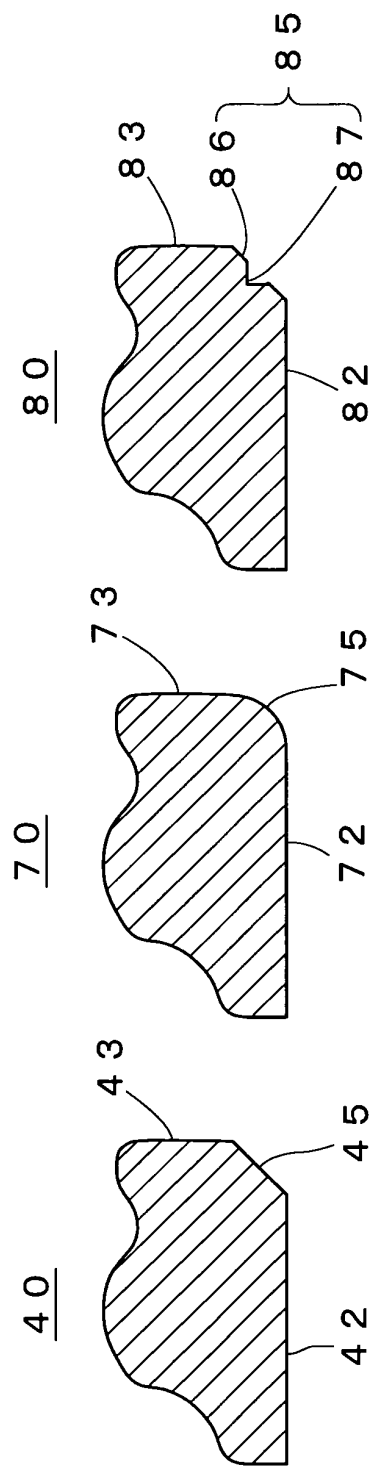


Fig. 4



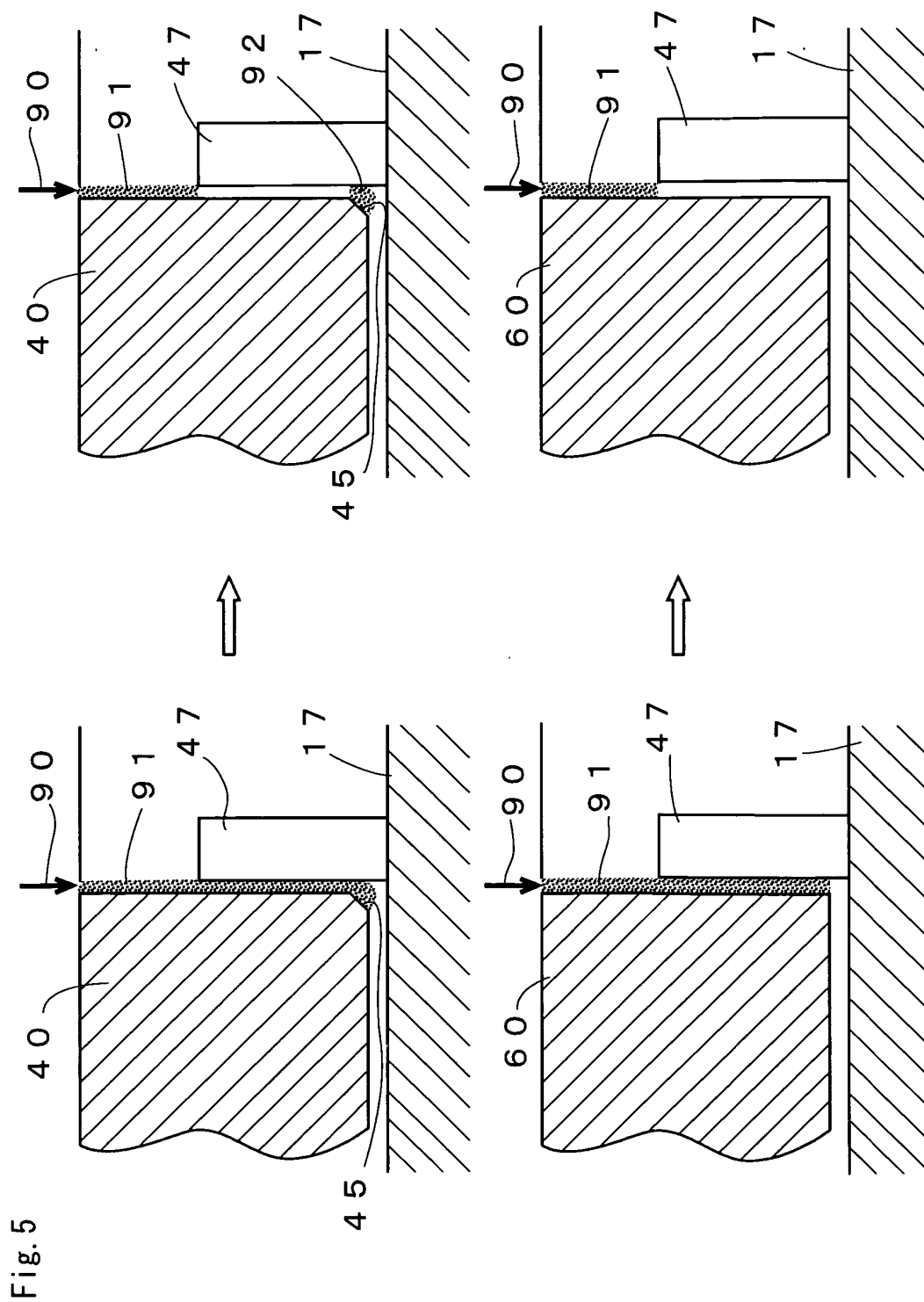


Fig. 6

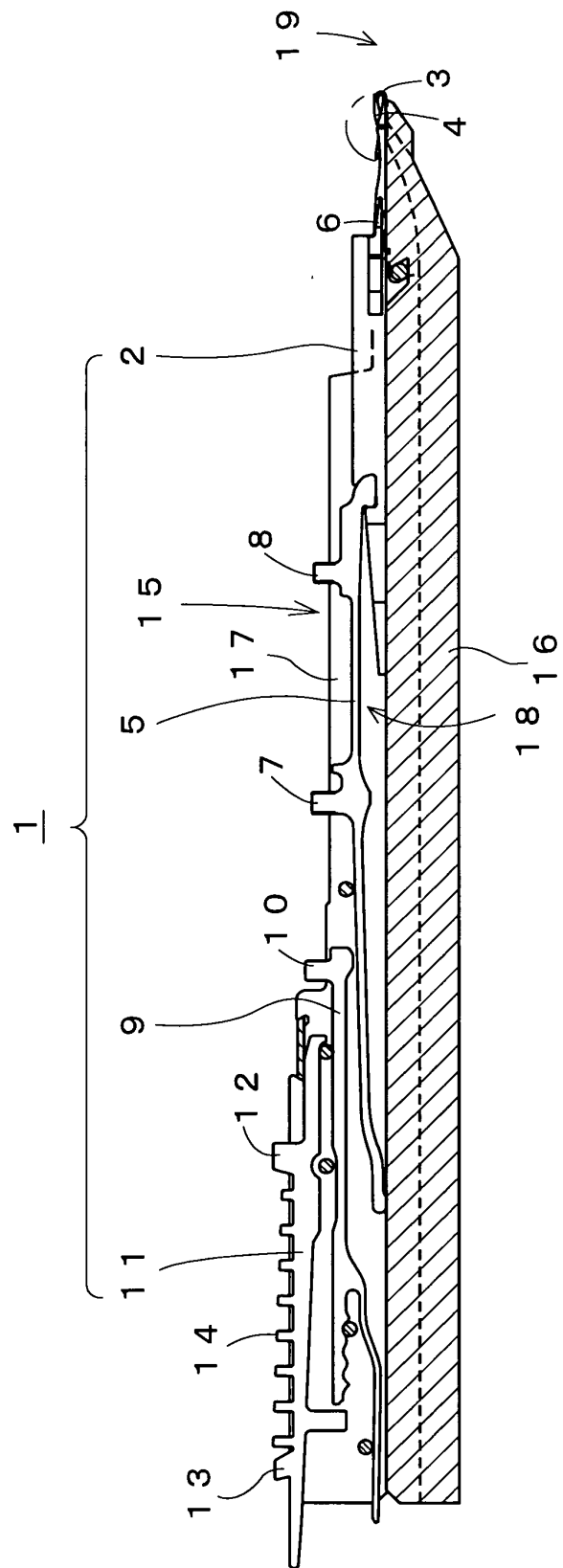
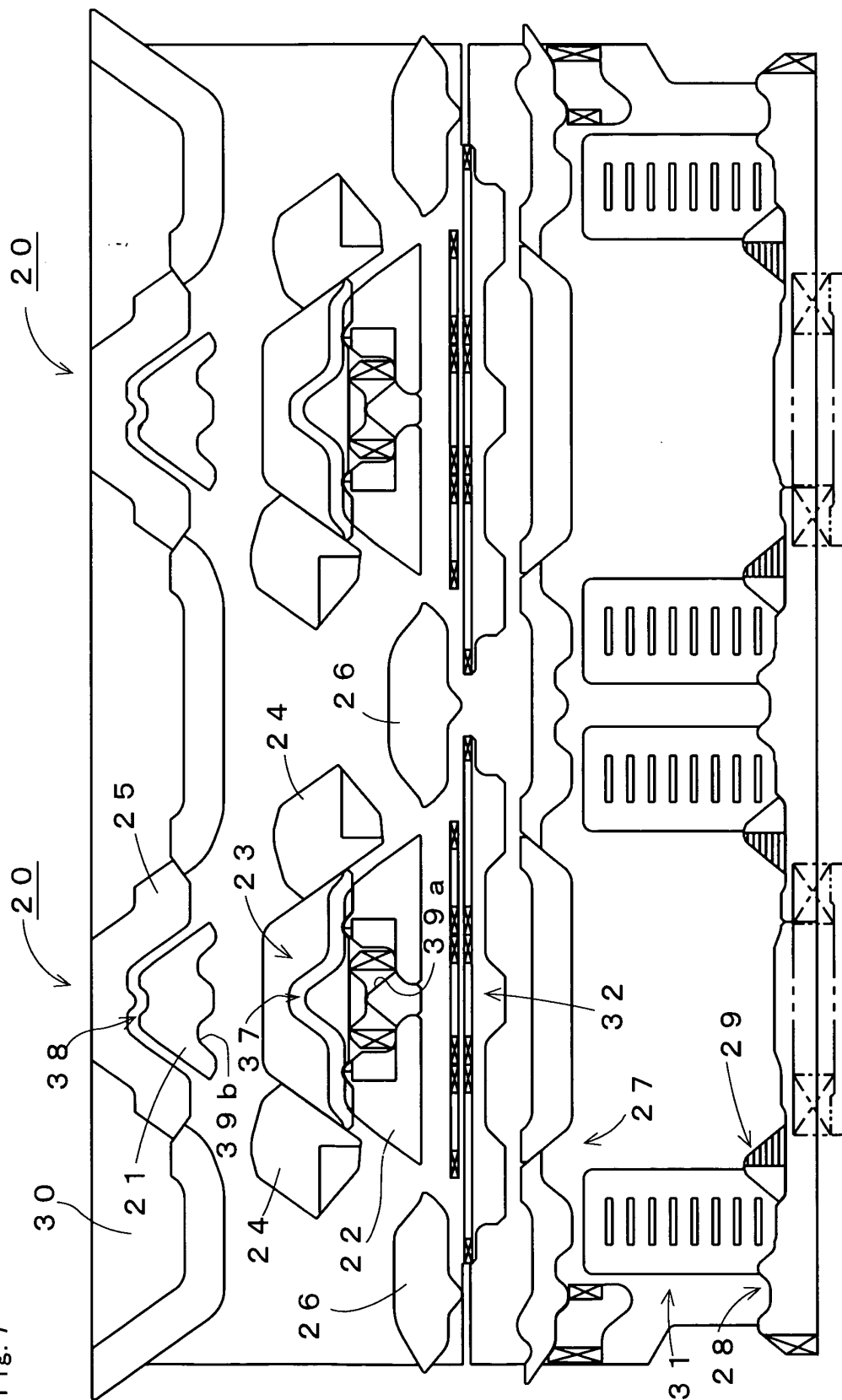


Fig. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/003391

A. CLASSIFICATION OF SUBJECT MATTER

D04B15/36 (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)

D04B15/36, D04B15/82

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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.
Y	WO 2007/074944 A1 (Shima Seiki Mfg., Ltd.), 05 July, 2007 (05.07.07), Full text; all drawings & EP 1975295 A1 & KR 10-2008-0081149 A & CN 101351587 A	1-4
Y	JP 4050399 B2 (Juki Corp.), 20 February, 2008 (20.02.08), Claim 25; Par. Nos. [0067], [0221]; Figs. 1 to 3 & US 6012404 A & DE 19841684 A & TW 494158 B & CN 1225402 A & CN 1515725 A & CN 1515726 A & CN 1515727 A & CN 1540053 A	1-4

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

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"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	

Date of the actual completion of the international search
31 July, 2009 (31.07.09)Date of mailing of the international search report
11 August, 2009 (11.08.09)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/003391

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2917146 B2 (Shima Seiki Mfg., Ltd.), 12 July, 1999 (12.07.99), Full text; all drawings & US 6018966 A & EP 890667 A2	1-4
A	JP 2929041 B2 (Shima Seiki Mfg., Ltd.), 03 August, 1999 (03.08.99), Par. Nos. [0004], [0005] (Family: none)	1-4
A	JP 3305635 B2 (Groz-Beckert KG.), 24 July, 2002 (24.07.02), Par. Nos. [0003] to [0010] & US 6112556 A & EP 838545 A3 & DE 19644166 C & ES 2195064 T	1-4

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REFERENCES CITED IN THE DESCRIPTION

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- WO 07074944 A [0009]
- JP 2917146 B [0009]