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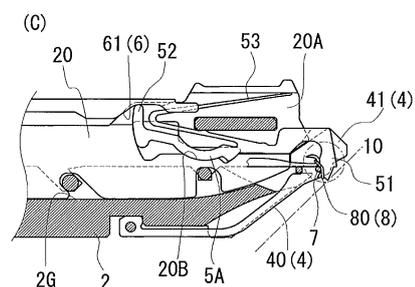
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(54) **FLAT KNITTING MACHINE**

(57) There is provided a flat knitting machine in which the knitting yarn is less likely to be nipped between a fixed sinker and a movable sinker. The flat knitting machine includes a fixed sinker 4 and a movable sinker 5. Assuming a direction from an inoperative position, where the movable sinker does not make contact with a sinker loop, to an operative position, where the movable sinker makes contact with the sinker loop, in a swinging direction of the movable sinker 5 is an operating direction, the movable sinker 5 includes a projecting portion 5C at a position closer to a swinging center than a knitting yarn receiving portion 5B when seen from the swinging center of the movable sinker 5. The projecting portion 5C is projected out more toward the operating direction than the knitting yarn receiving portion 5B. When a virtual line connecting a holding point of the knitting yarn 8 in the hook 3F when the knitting yarn 8 is pulled in with the hook 3F of the knitting needle 3 and a holding point of the knitting yarn 8 in the fixed sinker 4 is defined, the projecting portion 5C when the movable sinker 5 is arranged at the inoperative position is arranged on an upper side of the needle bed 2 than the virtual line.

Fig. 4



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a flat knitting machine equipped with both a fixed sinker and a movable sinker.

Description of the Related Art

[0002] Conventionally, in a flat knitting machine equipped with a pair of a front and a back needle bed having a plurality of knitting needles, a sinker parallel to each knitting needle is provided at a distal end portion on a needle bed gap side of the needle bed. The sinker is a member that forms a sinker loop connecting stitches by holding down a knitting yarn fed to a hook of the knitting needle so that the entire knitting yarn is not pulled in toward the needle bed side when the knitting yarn is pulled into the needle bed. The size of a stitch formed at the hook is decided by adjusting the pull-in amount of the knitting needle while forming the sinker loop with the sinker. The decision of the size of the stitch is referred to as "stitch decision". A sinker having such a function includes a fixed sinker (see Patent Document 1) immovably fixed at the distal end on the needle bed gap side of the needle bed, and a movable sinker (see Patent Document 2) swingably arranged at the distal end.

[0003] The fixed sinker is immovably arranged on the needle bed, and thus has an advantage in that the stitch decision can be carried out at high accuracy. A knitting yarn holding wire is inserted to a vicinity of a lower end on the needle bed gap side of the fixed sinker, which knitting yarn holding wire has a function of facilitating the knock-over of the stitch held on the hook when pulling in the knitting needle to form a new stitch. On the other hand, the movable sinker has, in addition to the function of stitch decision, a function of pushing down the sinker loop of a knitted fabric toward a lower side of the needle bed gap by being swung, as necessary, to facilitate the knitting of the knitted fabric. The movable sinker, however, is inferior to the immovable fixed sinker in the accuracy of stitch decision as the movable sinker is swung.

[0004] In recent years, a flat knitting machine in which both the fixed sinker and the movable sinker are arranged has been developed to exhibit the respective advantages of the fixed sinker and the movable sinker (see Patent Document 3). As opposed to the movable sinker of Patent Document 2 that is always in contact with the sinker loop, the movable sinker of Patent Document 3 is configured to make contact with the sinker loop as needed. Specifically, the movable sinker of Patent Document 3 is configured to be swingable between an inoperative position of not making contact with the sinker loop and an operative position of making contact with the sinker loop at a knitting yarn receiving portion to push down the sinker

loop toward the lower side of the needle bed gap. That is, the movable sinker of Patent Document 3 is a member dedicated for pushing down the sinker loop and does not have a function of stitch decision. The stitch decision is carried out by the fixed sinker. According to such configuration, the stitch decision can be carried out at high accuracy with the fixed sinker, and the sinker loop can be held down, as necessary, with the movable sinker to easily carry out the knitting.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0005]

[Patent Document 1] Japanese Examined Patent Publication No. 5-85664

[Patent Document 2] Japanese Examined Patent Publication No. 5-83657

[Patent Document 3] Japanese Unexamined Patent Publication No. 2015-132026

SUMMARY OF THE INVENTION

[0006] In the flat knitting machine in which both the fixed sinker and the movable sinker are arranged, if a tension of the knitting yarn is high when the knitting yarn receiving portion of the movable sinker makes contact with the knitting yarn and pushes down the knitting yarn at the time of operation, the movable sinker may yield to the tension and slightly bend. In such a case, a gap forms between the fixed sinker and the movable sinker arranged in parallel, and the knitting yarn may possibly get nipped in the gap. In a fine gauge flat knitting machine, in particular, the movable sinker easily bends as the thickness of the movable sinker is thin, and the knitting yarn is easily bitten in the gap between the sinkers as the knitting yarn used for the knitting is thin. If the knitting yarn is bitten, the swinging of the movable sinker is inhibited, and the quality of the knitted fabric may lower.

[0007] In light of the foregoing, it is an object of the present invention to provide a flat knitting machine in which the knitting yarn is less likely to be nipped between the fixed sinker and the movable sinker.

[0008] A flat knitting machine of the present invention includes a needle bed including a plurality of knitting needles; a fixed sinker immovably fixed on a needle bed gap side of the needle bed, the fixed sinker forming a sinker loop of a knitted fabric held on the needle bed; and a movable sinker arranged at a position parallel to the fixed sinker in the needle bed, and configured to be swung between an operative position of pushing down the sinker loop toward a lower side of the needle bed gap and an inoperative position of not making contact with the sinker loop. Assuming a direction from the inoperative position to the operative position in a swinging direction of the movable sinker is an operating direction, the movable

sinker includes a knitting yarn receiving portion that makes contact with the sinker loop to push down the sinker loop when swung in the operating direction. The movable sinker arranged in the flat knitting machine of the present invention further includes a projecting portion at a position adjacent to the knitting yarn receiving portion, the position being closer to a swinging center than the knitting yarn receiving portion when seen from the swinging center of the movable sinker. The projecting portion is projected out more toward the operating direction than the knitting yarn receiving portion. Furthermore, when a virtual line connecting a holding point of a knitting yarn in a hook when the knitting yarn is pulled in with the hook of the knitting needle and a holding point of the knitting yarn in the fixed sinker is defined, the projecting portion when the movable sinker is arranged at the inoperative position is arranged on an upper side of the needle bed than the virtual line.

[0009] According to one aspect of the flat knitting machine of the present invention, when seen from a longitudinal direction of the needle bed, the projecting portion is arranged on an inner side of a contour line of the fixed sinker within an entire swinging range of the movable sinker.

[0010] According to one aspect of the flat knitting machine of the present invention, the flat knitting machine further includes a knitting yarn holding wire extending in the longitudinal direction of the needle bed, the knitting yarn holding wire being inserted into a hole formed at a portion closer to the needle bed gap in the fixed sinker. According to such aspect, the swinging range of the movable sinker is set so that the projecting portion is interposed between the knitting yarn receiving portion and the knitting yarn holding wire when the movable sinker is at the operative position.

[0011] According to the configuration described above, when the movable sinker is swung in the operating direction and the knitting yarn receiving portion is brought into contact with the sinker loop hooked at the fixed sinker, a projecting portion 5C is interposed between a knitting yarn 8, which extends from a hook 3F of a knitting needle 3 to a fixed sinker 4, and the fixed sinker 4, as shown in Fig. 2 of the embodiment. Thus, the knitting yarn can be prevented from being bitten in a gap formed between the fixed sinker and the movable sinker even if the movable sinker is bent in a direction of moving away from the fixed sinker.

[0012] As the projecting portion is configured so as not to go beyond the contour line of the fixed sinker, the projecting portion can be prevented from inhibiting the knitting of the knitted fabric.

[0013] In accordance with the configuration in which the projecting portion is interposed between the knitting yarn receiving portion and the knitting yarn holding wire when the movable sinker is at the operative position, the knitting yarn can be suppressed from being nipped between the knitting yarn holding wire and the movable sinker (particularly, projecting portion).

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

- 5 Fig. 1 is a partial cross-sectional view of a vicinity of a needle bed gap side of a needle bed arranged in a flat knitting machine;
 Fig. 2 is a schematic top view on the needle bed gap side of the needle bed;
 10 Fig. 3 is a schematic configuration view of a movable sinker; and
 Fig. 4A is an explanatory view showing a state in which the movable sinker is at an inoperative position, Fig. 4B is an explanatory view showing a state in which the movable sinker is at a position immediately before making contact with a knitting yarn, and
 15 Fig. 4C is an explanatory view showing a state in which the movable sinker is at an operative position.

20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

<First Embodiment>

- 25 **[0015]** A flat knitting machine 1 according to an embodiment will be hereinafter described based on Figs. 1 to 4. The flat knitting machine 1 according to the embodiment may be a two-bed flat knitting machine or may be a four-bed flat knitting machine. In Fig. 1, only one needle bed 2 arranged in the two-bed flat knitting machine 1 is illustrated, but in the actual flat knitting machine 1, a needle bed having the same configuration as the illustrated
 30 needle bed 2 is arranged in line symmetry with a chain double dashed line in between. Furthermore, only a needle main body with a hook 3F of a knitting needle 3 arranged in the needle bed 2 is illustrated in Fig. 1, and only a portion in the vicinity of the hook 3F of the needle main body is illustrated in Figs. 4A to 4C. The knitting
 35 needle 3 may be a latch needle, or may be a compound needle including the needle main body with the hook and a slider.

«Overall configuration»

- 45 **[0016]** A plurality of plate grooves 2G arranged in parallel at a constant interval is formed in the needle bed 2 arranged in the flat knitting machine 1 in a longitudinal direction (depth direction in the plane of drawing) of the needle bed 2, where a needle plate 20 is fitted into each
 50 plate groove 2G. A space between the adjacent needle plates 20 functions as a needle groove, and the knitting needle 3 having the hook 3F at the distal end is accommodated in the needle groove. A fixed sinker 4 and a movable sinker 5 are arranged in parallel at a distal end
 55 portion on the needle bed gap 10 side of such needle bed 2 (see also schematic top view of the needle bed 2 shown in Fig. 2). The main difference between the flat knitting machine 1 of the present embodiment and the

conventional configuration lies in the configuration of the movable sinker 5. Therefore, a structure deeply related to the movable sinker 5 of the structures arranged in the flat knitting machine 1 will be mainly described in the following description.

«Needle plate»

[0017] The needle plate 20 basically has a configuration same as the needle plate arranged in the conventional flat knitting machine. As shown in Figs. 2 and 4, the needle plate 20 includes a thin-walled portion 20A formed by the distal end portion on the needle bed gap 10 side being locally thin. The thin-walled portion 20A becomes a space to arrange the movable sinker 5, to be described later. A rotation supporting portion 20B recessed to an arcuate shape toward the plate groove 2G side is formed in the thin-walled portion 20A, and an arcuate portion 5A of the movable sinker 5, to be described later, is fitted into such rotation supporting portion 20B.

«Fixed sinker»

[0018] The fixed sinker 4 shown in Figs. 4A to 4C is a thin member made from a metal material such as steel and the like, and includes a bent elongated arm portion 40, and a stitch deciding portion 41 having a flat plate shape formed at the distal end of the arm portion 40. One end (end on the opposite side of the stitch deciding portion 41) of the arm portion 40 is fixed to a lower part of the needle bed 2, so that the fixed sinker 4 is immovable with respect to the needle bed 2. The stitch deciding portion 41 is projected out toward the needle bed gap 10 side so as to be sandwiched between the adjacent knitting needles 3 as shown in Fig. 2. A hole is formed near the lower end on the needle bed gap 10 side of the stitch deciding portion 41, and a knitting yarn holding wire 7 extending in the longitudinal direction (depth direction in the plane of drawing) of the needle bed 2 is inserted into such hole (Figs. 1, 4).

[0019] The functions of the fixed sinker 4 and the knitting yarn holding wire 7 are similar to those of Patent Document 1. That is, as shown in Fig. 2, the fixed sinker 4 is a member that holds down a knitting yarn 8 with the stitch deciding portion 41 so that the entire knitting yarn 8 is not pulled in toward the needle bed 2 side and forms a sinker loop 80 of a knitted fabric when the knitting yarn 8 is pulled in toward the needle bed 2 side (side away from the needle bed gap 10) with the hook 3F of the knitting needle 3. The knitting yarn holding wire 7 is a member that allows an old stitch held by the hook 3F to be easily knocked over when pulling in the knitting yarn 8 with the hook 3F of the knitting needle 3 to form a new stitch.

«Movable sinker»

[0020] The movable sinker 5 is a thin member made

of a metal material such as steel and the like, and can be divided into an intermediate portion 50, a distal end portion 51, a back end portion 52, and an elastic leg piece 53, as shown in Fig. 3. The arcuate portion 5A is formed by curving a part of the intermediate portion 50. As shown in Figs. 4A to 4C, the movable sinker 5 is arranged in the thin-walled portion 20A of the needle plate 20, and the arcuate portion 5A of the movable sinker 5 is fitted into the rotation supporting portion 20B of the needle plate 20. The elastic leg piece 53 of the movable sinker 5 is arranged to make a slidable contact with a step surface of the thin-walled portion 20A and a thick-walled portion at the upper part thereof. According to such arrangement, the movable sinker 5 is configured to be swingable with a center of curvature of the arcuate portion 5A (rotation supporting portion 20B) as the swinging center 9X (see Fig. 3). A swinging angle of the movable sinker 5 is limited by a sinker jack 6, to be described later, and is an angle formed between the inoperative position where the movable sinker 5 does not make contact with the sinker loop 80, as shown in Fig. 4A, and the operative position where the movable sinker 5 makes contact with the sinker loop 80, as shown in Fig. 4C. The movable sinker 5 is energized in a clockwise direction in the figure on a constant basis by the elasticity of the elastic leg piece 53.

[0021] The movable sinker 5 further includes a knitting yarn receiving portion 5B and a projecting portion 5C at the position of the distal end portion 51. The knitting yarn receiving portion 5B has a known configuration, and is a portion that makes contact with the sinker loop 80 (see Fig. 4C) and pushes down the sinker loop 80 when the movable sinker 5 is swung in an operating direction 9D. The knitting yarn receiving portion 5B of the present example is formed to a linear form, similar to the knitting yarn receiving portion arranged in the conventional movable sinker described in Patent Document 3.

[0022] The projecting portion 5C has a configuration specific to the movable sinker 5 of the present embodiment. The projecting portion 5C is arranged at a position adjacent to the knitting yarn receiving portion 5B, the position being closer to the swinging center 9X than the knitting yarn receiving portion 5B when seen from the swinging center 9X of the movable sinker 5. The projecting portion 5C is projected out more toward the operating direction 9D than the knitting yarn receiving portion 5B, and is formed to a substantially hill shape in the present example. As shown in an encircled enlarged view of Fig. 4A, the projecting portion 5C when the movable sinker 5 is arranged at the inoperative position is arranged on the upper side of the needle bed 2 than the knitting yarn 8 extending from the hook 3F to the fixed sinker 4 when the knitting yarn 8 is pulled in with the hook 3F of the knitting needle 3. The knitting yarn 8 is extended along a virtual line connecting a holding point where the knitting yarn 8 is hooked in the hook 3F and a holding point where the knitting yarn 8 is hooked in the fixed sinker 4. That is, the projecting portion 5C of the movable sinker 5 at the inoperative position is arranged on the upper side of

the needle bed 2 than the virtual line. As the projecting portion 5C is arranged at such position, the projecting portion 5C does not make contact with the knitting yarn 8 when pulling in the knitting yarn 8 with the hook 3F and the projecting portion 5C does not inhibit the formation of stitches. As shown in Figs. 4A to 4C, the projecting portion 5C is arranged on the inner side of a contour line (see filled arrow) of the fixed sinker 4 within the entire swinging range of the movable sinker 5 when seen from the longitudinal direction of the needle bed 2. As shown in an encircled enlarged view of Fig. 4C, the projecting portion 5C is configured to be interposed between the knitting yarn receiving portion 5B and the knitting yarn holding wire 7 when the movable sinker 5 is at the operative position.

[0023] The movable sinker 5 of the present example is operated by a drive mechanism including the sinker jack 6 shown in Fig. 1. The sinker jack 6 is a long member that moves forward and backward in the extending direction of the knitting needle 3 on the needle bed 2, and includes a butt 60 and a recess 61. The butt 60 is a projection projecting out toward the upper side of the needle bed 2, arranged at a position on the back end side of the sinker jack 6. The recess 61 is a recess facing the upper surface of the needle bed 2, arranged at a position on the distal end side of the sinker jack 6. The sinker jack 6 is operated as the butt 60 engages with a cam of a carriage (not shown) that reciprocates in the longitudinal direction (depth direction in the plane of drawing) of the needle bed on the needle bed 2.

[0024] In the state shown in Fig. 4A, the back end portion 52 of the movable sinker 5 is abutted and stopped at the lower part of the sinker jack 6, and the movable sinker 5 is maintained at the inoperative position where the movable sinker 5 does not make contact with the knitting yarn 8 (sinker loop 80). When the butt 60 (see Fig. 1) of the sinker jack 6 is pulled down in a direction the cam of the carriage moves away from the needle bed gap 10 from the above state, the back end portion 52 of the movable sinker 5 is swung toward the upper side of the needle bed 2 along an inclined plane of the recess 61 of the sinker jack 6, as shown in Fig. 4B. The distal end portion 51 of the movable sinker 5 is energized toward the needle bed gap 10 side by the elastic leg piece 53, so that as the back end portion 52 is moved toward the upper side of the needle bed 2, the distal end portion 51 is lowered toward the lower side of the needle bed gap 10 and the knitting yarn receiving portion 5B is brought into contact with the sinker loop 80. Furthermore, when the sinker jack 6 is moved backward from the needle bed gap 10, the back end portion 52 of the movable sinker 5 is further swung to the upper side thus reaching the deepest position of the recess 61. As shown in Fig. 4C, the distal end portion 51 is thus lowered toward the lower side of the needle bed gap 10, and the knitting yarn receiving portion 5B is arranged at the operative position of pushing down the sinker loop 80 toward the lower side of the needle bed gap 10.

[0025] According to the flat knitting machine 1 described above, as the movable sinker 5 is swung in the operating direction 9D as shown in Figs. 4B and 4C, the projecting portion 5C is interposed between the knitting yarn 8, which extends from the hook 3F of the knitting needle 3 to the fixed sinker 4, and the fixed sinker 4, as shown in Fig. 2, slightly before the knitting yarn receiving portion 5B makes contact with the sinker loop 80 hooked at the fixed sinker 4. As opposed to the illustrated example, a configuration in which the projecting portion 5C is interposed between the knitting yarn 8 and the fixed sinker 4 at the same time as the knitting yarn receiving portion 5B makes contact with the sinker loop 80 may be adopted. With the projecting portion 5C interposed at the relevant position, even if a gap is formed between the fixed sinker 4 and the movable sinker 5 of Fig. 2, the knitting yarn 8 can be regulated from moving to such gap. As shown in Fig. 2, the projecting portion 5C is held down by the knitting yarn 8 in the first place, and hence the movable sinker 5 is less likely to bend in the direction of moving away from the fixed sinker 4, and the gap is less likely to be formed between the sinkers 4, 5. As a result, the knitting yarn 8 can be effectively suppressed from being bitten in the gap even with a very small projecting portion 5C, and the lowering in the quality of the knitted fabric accompanying the biting of the knitting yarn can be suppressed. Even with a configuration in which the projecting portion 5C is interposed in the gap after the knitting yarn receiving portion 5B is brought into contact with the sinker loop 80, the biting can be suppressed as long as the projecting portion 5C is interposed between the knitting yarn 8 and the fixed sinker 4 before the movable sinker 5 is bent.

[0026] In the flat knitting machine 1 of the present example, the projecting portion 5C is configured so as not to go beyond the contour line of the fixed sinker 4 even when the movable sinker 5 is at the operative position, as shown in Fig. 4C. Thus, the sinker loop 80 pushed down by the movable sinker 5 is moved along the contour line (see filled arrow) of the fixed sinker 4, and the projecting portion 5C does not inhibit the knitting of the knitted fabric.

[0027] Furthermore, in the flat knitting machine 1 of the present example, the projecting portion 5C is configured to be interposed between the knitting yarn receiving portion 5B and the knitting yarn holding wire 7 when the movable sinker 5 is at the operative position, as shown in Fig. 4C. Thus, the knitting yarn 8 can be suppressed from being nipped between the knitting yarn holding wire 7 and the movable sinker 5 (in particular, projecting portion 5C). A configuration in which the projecting portion 5C is arranged on the back side of the knitting yarn holding wire 7 (side moving away from the needle bed gap 10) when the movable sinker 5 is at the operative position may be adopted. In such a case as well, the knitting yarn 8 can be suppressed from being nipped between the fixed sinker 4 and the movable sinker 5 shown in Fig. 2.

<Modified Embodiment>

[0028] The entire shape of the movable sinker 5 is also not limited to the shape illustrated in the embodiment. The entire shape of the movable sinker 5 may be any shape as long as the position relationship of the knitting yarn receiving portion 5B and the projecting portion 5C arranged in the movable sinker 5 satisfies the relationship described above. For example, the movable sinker 5 may be configured by a substantially S-shaped main body and a wire spring as shown in Figs. 3 and 4 of Patent Document 2. The drive mechanism of the movable sinker 5 is not limited to the configuration using the sinker jack 6. For example, as shown in Figs. 3 and 4 of Patent Document 2, the movable sinker 5 may be driven by a cam that directly pushes the back end portion 52 of the movable sinker 5.

Claims

1. A flat knitting machine (1) comprising:

a needle bed (2) including a plurality of knitting needles (3) ;
 a fixed sinker (4) immovably fixed on a needle bed gap (10) side of the needle bed (2), the fixed sinker forming a sinker loop (80) of a knitted fabric held on the needle bed (2); and
 a movable sinker (5) arranged at a position parallel to the fixed sinker (4) in the needle bed (2), and configured to be swung between an operative position of pushing down the sinker loop (80) toward a lower side of the needle bed gap (10) and an inoperative position of not making contact with the sinker loop (80); and

assuming a direction from the inoperative position to the operative position in a swinging direction of the movable sinker (5) is an operating direction (9D), the movable sinker (5) includes a knitting yarn receiving portion (5B) that makes contact with the sinker loop (80) to push down the sinker loop (80) when swung in the operating direction (9D); **characterized in that**

the movable sinker (5) includes a projecting portion (5C) at a position adjacent to the knitting yarn receiving portion (5B), the position being closer to a swinging center (9X) than the knitting yarn receiving portion (5B) when seen from the swinging center (9X) of the movable sinker (5);
 the projecting portion (5C) is projected out more toward the operating direction (9D) than the knitting yarn receiving portion (5B); and
 when a virtual line connecting a holding point of a knitting yarn (8) in a hook (3F) when the knitting yarn (8) is pulled in with the hook (3F) of the knitting needle (3) and a holding point of the knitting yarn (8) in the

fixed sinker (4) is defined, the projecting portion (5C) when the movable sinker (5) is arranged at the inoperative position is arranged on an upper side of the needle bed (2) than the virtual line.

2. The flat knitting machine (1) according to claim 1, wherein when seen from a longitudinal direction of the needle bed (2), the projecting portion (5C) is arranged on an inner side of a contour line of the fixed sinker (4) within an entire swinging range of the movable sinker (5).

3. The flat knitting machine (1) according to claim 1 or 2, further comprising:

a knitting yarn holding wire (7) extending in the longitudinal direction of the needle bed (2), the knitting yarn holding wire (7) being inserted into a hole formed at a portion closer to the needle bed gap (10) in the fixed sinker (4); wherein the swinging range of the movable sinker (5) is set so that the projecting portion (5C) is interposed between the knitting yarn receiving portion (5B) and the knitting yarn holding wire (7) when the movable sinker (5) is at the operative position.

Fig. 1

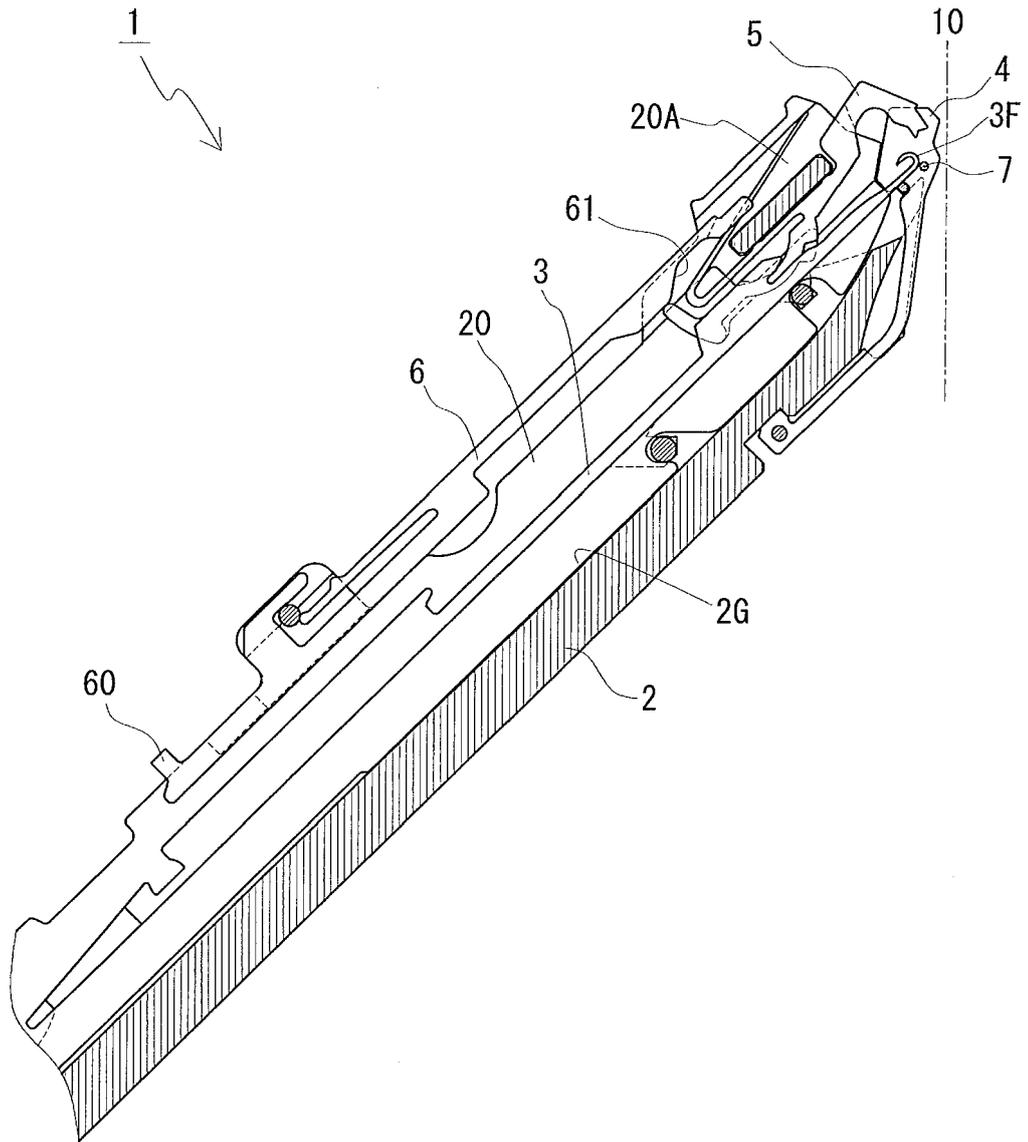


Fig. 2

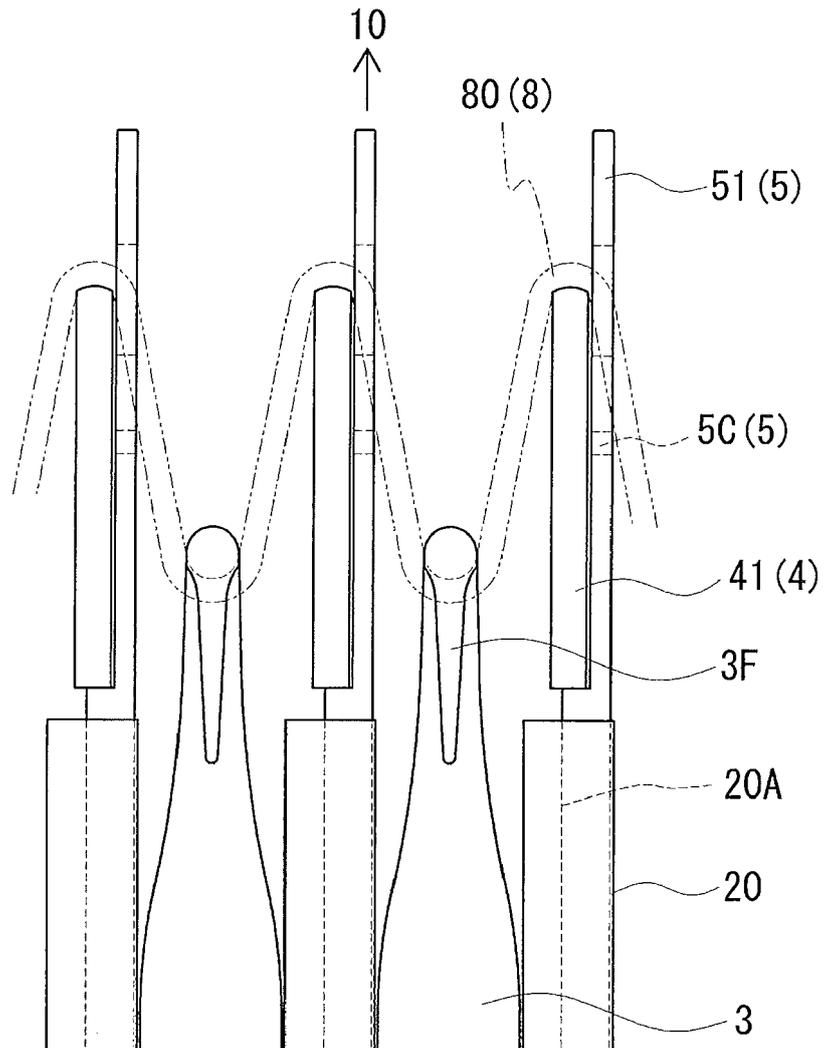


Fig. 3

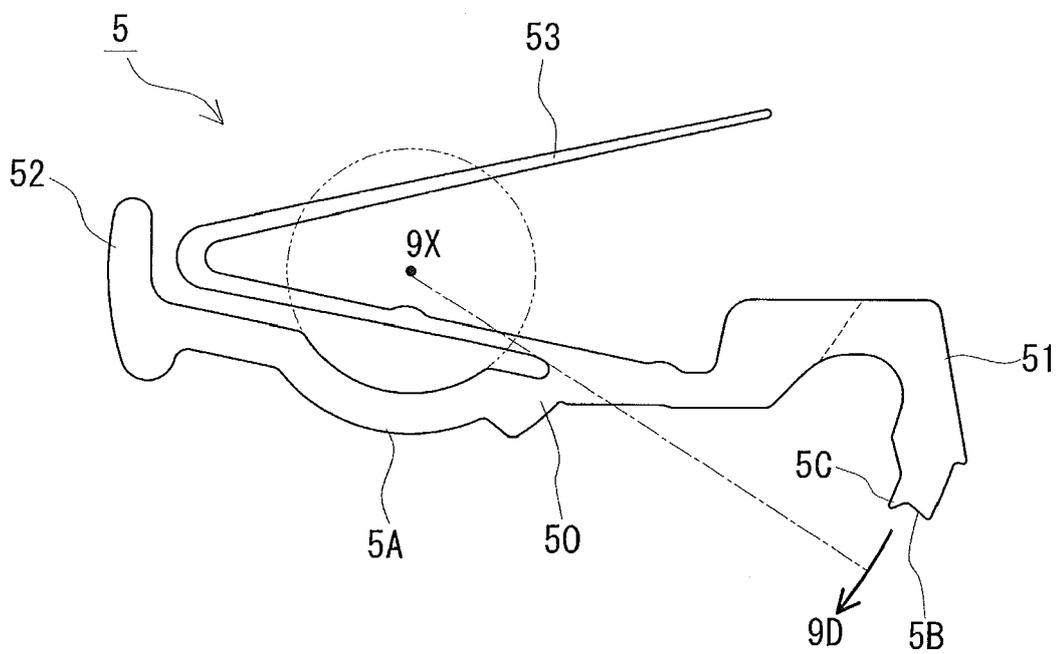
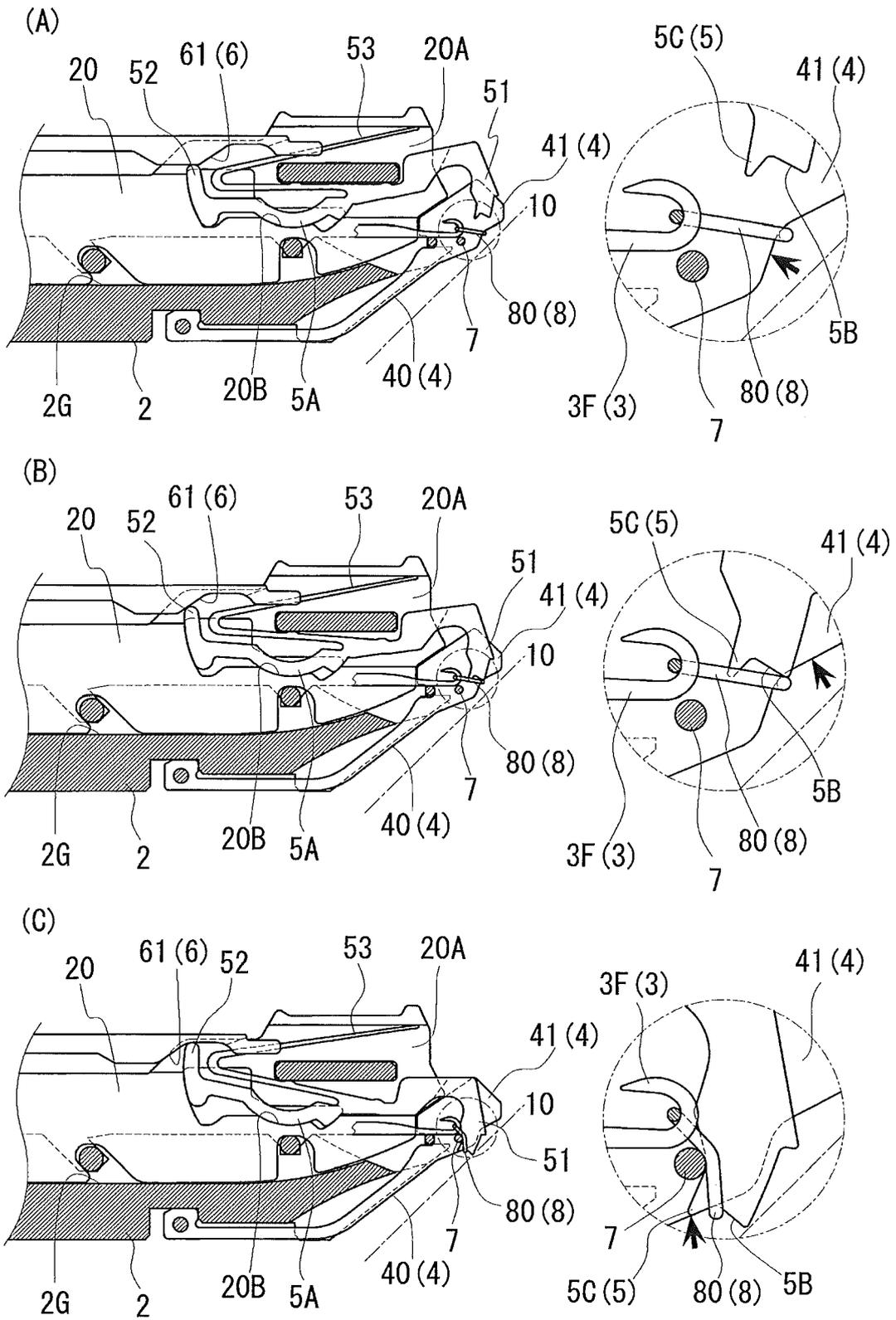


Fig. 4





EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
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A	* paragraph [0021] - paragraph [0040]; figures 1-7 *	2	
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Place of search Munich		Date of completion of the search 2 March 2017	Examiner Braun, Stefanie
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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