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(54) **Flatbed knitting machine equipped with movable sinker**

(57) [Problem to be solved] To provide a flatbed knitting machine equipped with movable sinkers, which can prevent increase in stress amplitude of a torque spring when the sinkers are opened and closed even when the movable sinkers are controlled directly by a sinker cam mounted on a carriage.

[Solution] A biasing cam surface 13a presses a leading end 12a of a torque spring 12 of which base end 12b is set to a portion between a support receive part 11a and a function arm 11b of a sinker 11 so as to bias the sinker 11 through the torque spring 12. The pressing force can be weakened in an opened state even when it is strengthened in a closed state. A stress of the torque spring 12 in the opened state also does not become larger than that in the closed state, so that an increase in the stress amplitude of the torque spring 12 is prevented when the sinker is opened and closed even with each movable sinker 10 controlled directly by the sinker cam mounted on the carriage.

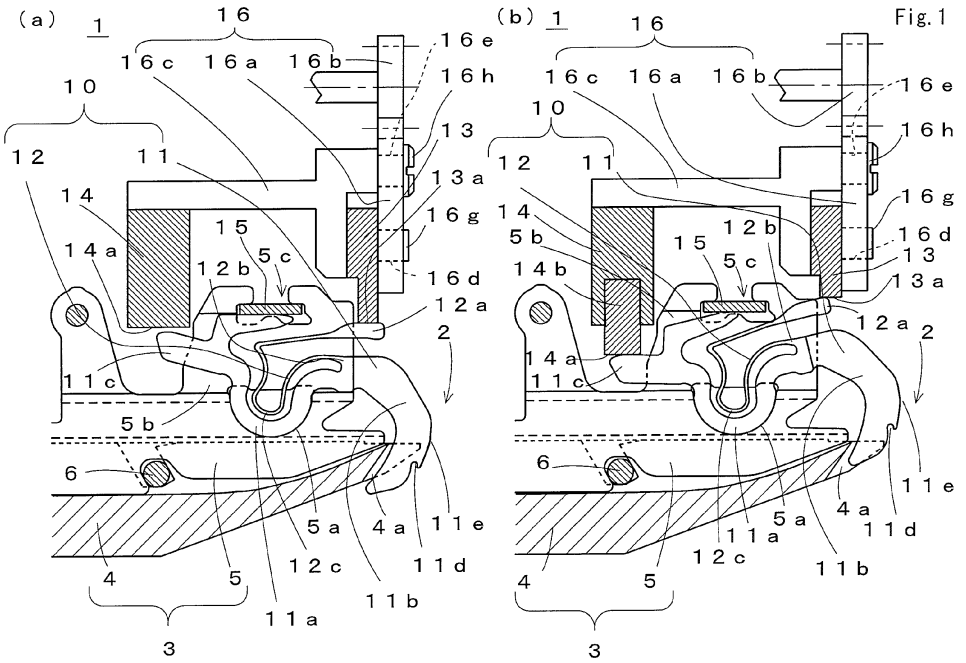

Fig.1

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Description

Technical Field

[0001] The present invention relates to a flatbed knitting machine equipped with movable sinkers that can press down a knitted fabric.

Background Art

[0002] Conventionally, it has been known that a flatbed knitting machine in which sinkers for forming knitted loops together with knitting needles in a needle bed gap are operated directly by a sinker cam mounted on a carriage so as to be opened and closed (see, Patent Citations 1 and 2, for example). Each movable sinker has a support receive part, a function arm, and a passive arm. The support receive part is supported on a needle bed in the vicinity of the needle bed gap in a manner capable of rocking displacement. The function arm extends from the support receive part in a direction of making closer to the needle bed gap. The passive arm extends from the support receive part in a direction of being apart from the needle bed gap. The support receive part is formed into a circular arc shape and is fitted into a support part recessed in a circular arc shape, which is provided on the needle bed. The support receive part is supported in a state of being capable of rocking while the center of the circular arc is set to a virtual supporting point. A torque spring of which base end is the function arm is also used in the movable sinker. The torque spring is accommodated in a space closer to the supporting point at the inner side relative to the support receive part of the sinker, and biases the function arm in the direction of advancing to the needle bed gap. The function arm is provided with a yarn receiving portion and has a function of pressing down a knitting stitch of a knitted fabric, which has been knitted and droops from the needle bed gap, to the lower side. The leading end of the torque spring is supported by a needle plate standing on the needle bed.

[0003] When the knitted loop is formed by making a knitting needle advance to the needle bed gap and feeding a knitting yarn to a hook, and so on, the function arm needs to be made to retreat from the needle bed gap. To the closed state in which the function arm is made to advance into the needle bed gap with the biasing by the torque spring, when the function arm is made to retreat to the needle bed side from the needle bed gap against biasing by the torque spring, the sinker is made into an opened state. In order to make the sinker into the opened state, a rear cam for sinker control, which acts on the passive arm of the sinker, is mounted on the carriage travelling along the needle bed so as to face a rear position of the sinker apart from the needle bed gap relative to the support receive part thereof. In the opened state, the torque spring is pressed and compressed at the maximum level, so that the stress thereof is the largest. On the other hand, the stress thereof is decreased in the closed state. In a non-load state where there is no knitted fabric to be pressed down to the lower side in the needle bed gap, the function arm advances into the needle bed gap at the maximum level, so that the stress of the torque spring is the smallest. In order to obtain a large pressing force in the closed state, the stress of the torque spring in the opened state is increased, resulting in a risk that the spring exceeds the deflection limit.

[0004] Patent Citation 1 discloses the basic structure of the movable sinker as described above. Patent Citation 2 discloses a structure in which a knitting yarn drop-preventing means is provided, which prevents the knitting yarn at the leading end of the needle bed from dropping in a sinker guide groove in which the function arm advances and retreats.

Citation List

Patent literature

[0005] Patent Citation 1: Japanese Patent Publication No. H05-83657B Patent Citation 2: Japanese Patent No. 2700204B

Summary of Invention

Technical Problem

[0006] In the movable sinker as described in Patent Citation 1 or 2, stress amplitude of the torque spring is increased due to change of the torque when the sinker is opened or closed.

[0007] An object of the present invention is to provide a flatbed knitting machine equipped with movable sinkers, which can prevent increase in stress amplitude of torque springs when the sinkers are opened and closed even when the movable sinkers are controlled directly by a sinker cam mounted on a carriage.

Solution to Problem

[0008] The present invention provides a flatbed knitting machine equipped with movable sinkers, in which a plurality of sinkers are provided to be arranged at a leading end side of a needle bed facing a needle bed gap in such a manner that
each sinker:

having a support receive part, a function arm curved and extending forward from the support receive part to the needle bed gap side, and a passive arm provided backward at a side apart from the needle bed gap relative to the function arm, and the support receive part supported on the needle bed in the vicinity of the needle bed gap in a manner capable of rocking displacement;
having a torque spring extending to a leading end while a portion between the function arm and the

support receive part set to a base end of the torque spring and capable of biasing the function arm in a direction in which the function arm advances into the needle bed gap; and
being capable of switch over between a closed state where the function arm advances into the needle bed gap and an opened state where the function arm retreats from the needle bed gap, by a sinker cam mounted on a carriage reciprocating along the needle bed,

characterized in that
the leading end of the torque spring protrudes to an outward of the needle bed,
the sinker cam comprises:

a biasing cam surface having concavity and convexity in a direction in which pressing force is made to act on the leading end of the torque spring; and
an open/close cam surface that controls opened and closed states of the sinker with concavity and convexity acting on the passive arm of the sinker, under such a phase relation that:

the biasing cam surface is switched to the convexity and the open/ close cam surface is switched to concavity in the close state of the sinker;
the biasing cam surface is switched to the concavity and the open/ close cam surface is switched to the convexity in the opened state of the sinker; and

the sinker cam switches the sinker:

into the opened state when feeding of a knitting yarn is received by a knitting needle that has advanced into the needle bed gap; and into the closed state when the knitting needle which has received the knitting yarn is drawn to the needle bed.

[0009] The flatbed knitting machine equipped with the movable sinkers according to the present invention,
further comprising a pressing force adjusting means that changes a position of said biasing cam surface of said sinker cam in a direction in which said pressing force is made to act so as to adjust the pressing force of said torque spring on said leading end in said closed state of said sinker.

[0010] In the flatbed knitting machine equipped with the movable sinkers according to the present invention,
said leading end of said torque spring protrudes to said forward relative to said support receive part of said sinker, and
said passive arm of the sinker protrudes to said backward relative to the support receive part, and
said sinker cam is provided to be divided into:

a torque spring control cam on which said biasing cam surface is formed at a position facing the leading end of the torque spring, and
an open/close control cam on which said open/close cam surface is formed at a position facing the passive arm of the sinker.

[0011] In the flatbed knitting machine equipped with the movable sinkers according to the present invention,
said passive arm of said sinker bifurcates from a position between said function arm and said support receive part so as to protrude in an upward direction of floating from the needle bed,
said leading end of said torque spring protrudes upward from a position farther in said backward relative to the passive arm,
said sinker cam:

has said biasing cam surface and said open/close cam surface that are opposed to each other at said backward and said forward respectively at an interval,
so as to accommodate the leading end of the passive arm of the sinker and the leading end of the torque spring between the open/ close cam surface and the biasing cam surface.

Advantageous Effects of Invention

[0012] According to the present invention, a sinker cam switching an opened state and a closed state of each sinker that is capable of rocking displacement is mounted on a carriage and has a biasing cam surface and an open/ close cam surface for operating the sinker directly. The open/ close cam surface controls the switching between the closed state where a function arm of the sinker advances into a needle bed gap and the opened state where the function arm retreats from the needle bed gap with concavity and convexity acting on a passive arm of the sinker. The biasing cam surface has concavity and convexity in the direction in which pressing force is made to act so as to press a leading end of a torque spring, and biases the sinker in the direction in which the function arm advances into the needle bed gap through the torque spring. The pressing force can be weakened in the opened state even if it is strengthened in the closed state. The stress of the torque spring in the opened state is not larger than that in the closed state. It is possible to prevent the increase in the stress amplitude of the torque spring when the sinker is opened and closed even with the movable sinker that is directly controlled by the sinker cam mounted on the carriage.

[0013] According to the present invention, the pressing force adjusting means can change the position of the biasing cam surface of the sinker cam in the closed state of the sinker in the direction in which the pressing force is made to acts. After a hook of a knitting needle that has advanced into the needle bed gap receives feeding of a

knitting yarn for forming a new loop, the knitting yarn of an old loop retained on the knitting needle is pressed in by a yarn receiving portion of the sinker with the pressing force while the hook is made to retreat from the needle bed gap to be drawn into the needle bed. The pressing force is changed so as to adjust the force of pressing the knitting yarn by the sinker in accordance with conditions when the knitted fabric is knitted, such as the size of the knitting stitch and the strength of the knitting yarn.

[0014] According to the present invention, the sinker cam is provided to be divided into a torque spring control cam on which the biasing cam surface facing the leading end of the torque spring is formed and an open/close control cam on which the open/close cam surface facing the passive arm of the sinker is formed. Even if the torque spring control cam can be arranged in the same manner as the conventional front cam and the open/ close control cam can be arranged in the same manner as the conventional rear cam, it is not to increase the stress amplitude when the sinker is opened and closed.

[0015] According to the present invention, the sinker cam can be driven while accommodating the leading end of the passive arm of the sinker and the other end of the torque spring as two butts protruding from the needle bed side between the open/close cam surface and the biasing cam surface, which are opposed to each other.

Brief Description of Drawings

[0016]

[Fig. 1] Figs. 1 are side cross-sectional views showing a schematic structure and operations of a flatbed knitting machine 1 equipped with movable sinkers 10 according to an example 1 of the present invention.

[Fig. 2] Figs. 2 are cam arrangement views showing arrangement of cams that are mounted on a carriage used in the flatbed knitting machine 1 according to the example 1 of the present invention in a simplified manner.

[Fig. 3] Figs. 3 are a side view and a side cross-sectional view showing shapes of a sinker 11 and a torque spring 12 constructing the movable sinker 10, and shapes of a base board 4 and a needle plate 5 constructing a needle bed 3, shown in Figs. 1.

[Fig. 4] Figs. 4 are side cross-sectional views showing a schematic structure and operations of a flatbed knitting machine 21 equipped with movable sinkers 30 according to an example 2 of the present invention.

[Fig. 5] Figs. 5 are a side view and a side cross-sectional view showing shapes of a sinker 31 and a torque spring 32 constructing the movable sinker 30, and shapes of a base board 24 and a needle plate 25 constructing a needle bed 23, shown in Figs. 4.

Description of Embodiments

[0017] Hereinafter, Figs. 1, 2, and 3 show a structure and operations of a flatbed knitting machine 1 equipped with movable sinkers 10 according to an example 1 of the present invention. Figs. 4 and 5 show a structure and operations of a flatbed knitting machine 21 equipped with movable sinkers 30 according to an example 2 of the present invention. Components in the example 1 and the example 2, which correspond to each other, are denoted by reference numerals of which numerical values are different by 20. In description of the example 2, overlapped descriptions of components corresponding to those in the example 1 are omitted. Further, components that are not shown in the drawing as a description target are referred by using reference numerals as shown in other drawings in some cases.

[0018] Although a needle bed 3, 23 of an actual flatbed knitting machine 1, 21 is inclined in such a manner that a side of a needle bed gap 2, 22 is higher and a side apart from the needle bed gap 2, 22 is lower, in Figs. 1 and Figs. 4 the needle bed 3, 23 is shown in a horizontal posture for convenience of explanation. Further in the flatbed knitting machine 1, 21 at least one pair of needle beds 3, 23 are provided so as to interleave the needle bed gap 2, 22 and so as to be opposed to each other, but the single needle bed 3, 23 only is shown. Hereinafter, the direction toward the needle bed gap 2, 22 along the needle bed 3, 23 is set to the forward and the direction of being apart from the needle bed gap 2, 22 is set to the backward. The direction of floating from the needle bed 3, 23 is set to the upward and the direction of sinking in the needle bed 3, 23 is set to the downward.

[0019] Although the knitting needle and the like are used together with the movable sinker 10, 30, they are not shown in the drawings for convenience of explanation. Further, the knitting yarn drop-preventing means as disclosed in Patent Citation 2 is also provided but it is also omitted to be shown in the drawings.

Example 1

[0020] Figs. 1 show a schematic structure and operations of a flatbed knitting machine 1 equipped with movable sinkers 10 in an example 1, in a closed state as shown in Fig. 1(a) and in an opened state as shown in Fig. 1 (b) respectively. In the flatbed knitting machine 1, a needle bed 3 is formed by arranging needle plates 5 on a base board 4 in parallel for knitting a knitted fabric at a side of a needle bed gap 2. Needle grooves are formed between the needle plates 5 arranged in parallel at a constant pitch in a direction perpendicular to a paper plane. Knitting needles such as latch needles or compound needles are accommodated in the needle grooves. The base board 4 and the needle plates 5 are positioned by a wire 6 penetrating through in the direction perpendicular to the paper plane. A sinker guide groove 4a is provided at the leading end of the base board 4,

which faces the needle bed gap 2.

[0021] The movable sinker 10 is provided with a sinker 11 and a torque spring 12. The sinker 11 and the torque spring 12 however are integrated. The plurality of movable sinkers 10 are provided so as to be arranged on the needle bed 3 at the leading end side, which faces the needle bed gap 2. Each sinker 11 has a support receive part 11 a, a function arm 11b, and a passive arm 11c. The function arm 11b is curved and extends from the support receive part 11 a to the needle bed gap 2 side. The passive arm 11c is provided so as to protrude backward from the support receive part 11 a. The torque spring 12 extends to a leading end 12a while a base end 12b thereof is set to a portion between the support receive part 11 a and the function arm 11b of the sinker 11. The leading end 12a of the torque spring 12 protrudes forward to the front side of the needle plate 5. In each movable sinker 10 in the present example, the sinker 11 and the torque spring 12 are formed integrally by performing punching process on a plate-like metal material. However, the sinker 11 and the torque spring 12 may be formed as separate bodies. When they are formed as the separate bodies, it is sufficient that a wire spring is used as the torque spring to be retained on a spring retaining part provided on the sinker in the same manner as Patent Citation 1 for example.

[0022] The support receive part 11a, its circular arc-like outer circumference is fitted into a sinker support part 5a as a circular arc-like recess provided on the needle plate 5 in the vicinity of the needle bed gap 2,is supported in a manner capable of rocking-displacement. In the movable sinker 10, the sinker 11 is accommodated in a sinker accommodating part 5b provided on the needle plate 5, and the movable sinker 10 can be switched between a closed state where the function arm 11b rocks in the direction of advancing to the needle bed gap 2 and an opened state where the function arm 11b rocks in the direction of being apart from the needle bed gap 2. The switching is performed by directly operating the movable sinker 10 by a torque spring control cam 13 and an open/close control cam 14 as a sinker cam mounted on a carriage reciprocating along the needle bed 3. A biasing cam surface 13a is formed on the torque spring control cam 13. The biasing cam surface 13a causes pressing force to act on the leading end 12a of the torque spring 12 with concavity and convexity. An open/close cam surface 14a is formed on the open/close control cam 14. The open/close cam surface 14a switches open or close with respect to the passive arm 11c of the sinker 11 with convexity or concavity. The leading end 12a of the torque spring 12 and the passive arm 11c protrude to the outer sides of the needle bed 3 formed by the needle plate 5 and the base board 4 at the forward and backward sides of the sinker accommodating part 5b, so that the leading end 12a of the torque spring 12 and the passive arm 11c can receive actions of the biasing cam surface 13a and the open/close cam surface 14a, respectively.

[0023] In the closed state as shown in Fig. 1(a), a convex portion of the biasing cam surface 13a of the torque spring control cam 13 presses the leading end 12a of the torque spring 12 downward. As for the open/close cam surface 14a of the open/close control cam 14, a concave portion corresponds to the convex portion of the biasing cam surface 13a is established in a phase relation. The torque spring 12 biases the sinker 11 such that the sinker 11 rocks in the clockwise direction in Fig. 1(a) through the base end 12b. The sinker 11 is biased such that the function arm 11b advances into the side of the needle bed gap 2. The function arm 11b has a yarn receiving portion 11d and a sinker loop forming portion 11e. The support receiving part 11 a of the sinker 11 makes rocking-displacement around a virtual center of the circular-arc outer circumference as a supporting point 11f.

[0024] In the opened state as shown in Fig. 1(b), the passive arm 11c of the sinker 11 can be operated to be pressed down by a convex portion of the open/close cam surface 14a so as to cause the sinker 11 to make rocking displacement in the counterclockwise direction such that the function arm 11b retreats to the needle bed 3 side from the needle bed gap 2. As for the biasing cam surface 13a of the torque spring control cam 13, a concave portion corresponds to the convex portion of the open/close cam surface 14a is established in a phase relation, and the concave portion can be functioned as a stopper restricting the elevation of the leading end 12a of the torque spring 12. The position at which the elevation of the leading end 12a of the torque spring 12 is restricted can be made higher than a position at which it is fixed to the needle plate as in Patent Citations 1 and 2, thereby decreasing the stress of the torque spring 12. In the opened state, if the biasing cam surface 13a is separated from the leading end 12a of the torque spring 12 so as not to act thereon, the stress of the torque spring 12 can be made smallest. The biasing cam surface 13a adjusts the biasing of the sinker 11 by the torque spring 12 with the pressing force on the leading end 12a of the torque spring 12 of which base end 12b is set to the portion between the support receive part 11a and the function arm 11b of the sinker 11, so that the biasing degree by the torque spring 12 can be weakened in the opened state even if it is strengthened in the closed state. The stress of the torque spring 12 in the opened state is not larger than that in the closed state, and the movable sinker 10 that is directly controlled by the sinker cam mounted on the carriage makes it possible to prevent the increase in the stress amplitude of the torque spring 12 when the sinker is opened and closed.

[0025] The torque spring control cam 13 and the open/close control cam 14 as described above can be arranged at positions same as a "front cam 4" and a "rear cam 3" in Fig. 1 of Patent Citation 1 for example, so that a concave portion of the biasing cam surface 13a is provided at a position higher than the position at which a " free end 28a of a wire spring 28" is pressed down and biased by a "pressing plate 34" to restrict elevation of the leading end 12a of the torque spring 12 in the opened

state and to prevent the increase in the stress amplitude when the sinker is opened and closed. Also in the present example, the sinker 11 is pressed so as not to float upward by a metal band 15 penetrating through a band metal penetrating portion 5c provided on the needle plate 5 in the direction perpendicular to the paper plane.

[0026] The present example further has a pressing force adjusting means 16, which changes the position of the biasing cam surface 13a of the torque spring control cam 13 as the sinker cam in the direction in which the pressing force is made to act so as to adjust the pressing force on the leading end 12a of the torque spring 12 in the closed state of the sinker 11. The pressing force adjusting means 16 has a control plate 16a, a pinion gear 16b, and a mounting base 16c. The pinion gear 16b is rotationally driven by a driving source such as a motor, which is omitted to be shown in the drawing. The control plate 16a includes a rack 16f that is engaged with the pinion gear 16b, as shown in Fig. 2(a). The rotation of the pinion gear 16b causes the control plate 16a to move in the direction perpendicular to the paper plane of Figs. 1. A groove cam 16d and a guide groove 16e are formed on the control plate 16a. Shaft portions of a pin 16g and a guide screw 16h are fitted into the groove cam 16d and the guide groove 16e, respectively. When the control plate 16a is moved in the direction perpendicular to the paper plane of Figs. 1, the torque spring control cam 13 is moved in the up-down direction in Figs. 1 and the position of the biasing cam surface 13a in the up-down direction is changed, so that the strength of the pressing force acting on the leading end 12a of the torque spring 12 is adjusted weaker or stronger. The mounting base 16c is used for mounting and supporting the pressing force adjusting means 16 on the carriage.

[0027] Such pressing force adjusting means 16 is used so as to change the position of the biasing cam surface 13a in the closed state of the sinker 11 in the direction in which the pressing force is made to act. After feeding of the knitting yarn for forming a new loop is received on the hook of the knitting needle that has advanced into the needle bed gap 2, the knitting yarn of an old loop retained on the knitting needle is pressed in by the yarn receiving portion 11d of the sinker 11 with the pressing force while the hook is made to retreat from the needle bed gap 2 to be drawn into the needle bed 3. The pressing force is changed so as to adjust the force of pressing the knitting yarn by the sinker 11 in accordance with knitting conditions, such as the size of the knitted loop and the strength of the knitting yarn.

[0028] The pressing force adjusting means 16 is provided with the rack 16f on the control plate 16a and is driven through the pinion gear 16b, in addition thereto, in particular when switching is performed at two stages, the control plate 16a may be driven directly by an actuator such as a cylinder and a solenoid. Further, the torque spring control cam 13 may be moved directly by an actuator. When the number of stages of switching is large, a ball screw may be used.

[0029] Figs. 2 show arrangement of the cams that are mounted on the carriage and are used in the case where latch needles are used as the knitting needles in the flat-bed knitting machine 1 according to the example 1 of the present invention in a simplified manner. Fig. 2(a) shows arrangement of the torque spring control cam 13 and the open/close control cam 14, while the upward direction is the direction facing the needle bed 3. Fig. 2(b) includes arrangement of a knitted loop formation cam 17 and a transferring cam 18. The knitted loop formation cam 17 includes stitch cams 17a, 17b and a needle raising cam 17c. The cams make equivalent actions when the carriage travels to the left side and the right side. The following explanation describes assuming the carriage travels to the left side.

[0030] When the control plate 16a is moved to the left side of the paper plane by driving the rack 16f, the torque spring control cam 13 presses up the pin 16g with which the groove cam 16d is fitted so as to change the position of the biasing cam surface 13a upward. The groove cam 16d of the present example can change the position of the biasing cam surface 13a at three stages. The number of stages of the groove cam 16d can change the number of switching stages of the position, further if the groove cam 16d is formed by a continuous inclined groove, the position of the biasing cam surface 13a can be changed with no stage. The shaft portion of the guide screw 16h fixed to the mounting base 16c is fitted into the guide groove 16e so as to guide the control plate 16a to move from side to side in the drawing. The torque spring control cam 13 includes a guide groove 16i extending in the up-down direction in the drawing and the shaft portion of a guide screw 16j provided on the mounting base 16c is fitted into the guide groove 16i so as to be guided to move in the up-and down direction. The upward direction in Fig. 2(a) corresponds to the downward direction in Figs. 1.

[0031] As for the open/close control cam 14, the convex portion of the open/close cam surface 14a is provided on a moving cam 14b. When the moving cam 14b abuts against the passive arm 12c of the sinker 12 after the carriage starts traveling to the left side, it moves to the right side along a groove 14c and causes the function arm 11b of the sinker 11 to retreat from the needle bed gap 2 and makes the sinker 12 into the opened state at a position A where the knitting needle receives feeding of the knitting yarn in the needle bed gap 2. Further, a movable cam 14d for causing the yarn receiving portion 11d of the sinker 11 to once retreat from the needle bed gap 2 is also provided on the open/close control cam 14 at the leading side in the traveling direction of the carriage. In case the carriage travels to the right side, the movable cam 14d is switched to a movable cam 14e. Further at a position B where the stitch cam 17b draws the knitting needle, the convex portion of the biasing cam surface 13a is made to correspond to the movable cam 14e. The pressing force acting on the leading end 12a of the torque spring 12 can be adjusted by the position

of the biasing cam surface 13a, so that the pressing force becomes larger as the biasing cam surface 13a is closer to the needle bed 3 while it is smaller as the biasing cam surface 13a is farther from the needle bed 3.

[0032] Fig. 3 shows the shapes of the sinker 11 and the torque spring 12 constructing the movable sinker 10, and shapes of the base board 4 and the needle plate 5 constructing the needle bed 3, shown in Figs. 1. A curved portion 12c folded between the leading end 12a and the base end 12b can be provided on the torque spring 12. The curved portion 12c can have a shape bypassing the supporting point 11f at the inner side of the support receive part 11a of the sinker 11. The supporting point 11f corresponds to the virtual center of the circular arc, which is the outer circumference of the support receive part 11 a.

[0033] The needle plate 5 has the sinker supporting portion 5a, the sinker accommodating part 5b, and the band metal penetrating portion 5c, and is fixed while a lower portion of the needle plate 5 is inserted into a groove formed on the base board 4.

[0034] The torque spring 12 may have a different shape as long as it can generate a torque for rocking displacement of the sinker 11. As in the present example, when the sinker 11 and the torque spring 12 are integrated, the torque spring 12 needs to be made of a material same as that of the sinker 11, by the integration, however, the number of parts constructing each movable sinker can be reduced and the number of assembling processes can be reduced. If the torque spring 12 and the sinker 11 are formed as separate bodies, the torque spring 12 can be made of an elastic material different from that of the sinker 11.

Example 2

[0035] Figs. 4 show a schematic structure and operations of a flatbed knitting machine 21 equipped with movable sinkers 30 as an example 2 of the present invention, as for the opened state in Fig. 4(a) and as for the closed state in Fig. 4(b) respectively. In the present example, a passive arm 31c of a sinker 31 bifurcates from a position between a function arm 31 b and a support receive part 31a so as to protrude to the upward of a needle plate 25. A leading end 32a of a torque spring 32 protrudes to the upward of the needle plate 25 at the backward position relative to the passive arm 31c. The needle plate 25 forms a needle bed 23 together with a base board 24, and the passive arm 31c and the leading end 32a of the torque spring 32 protrude at the outer side of the needle bed 23.

[0036] A sinker cam accommodates the leading end of the passive arm 31c of the sinker 31 and the leading end 32a of the torque spring 32 as two butts protruding from the needle bed 23 between an open/close cam surface 34a of an open/close control cam 34 and a biasing cam surface 33a of a torque spring control cam 33, which are opposed to each other. Although the arrangement of the cams in the present example is different from that in the example 1, corresponding cams are provided and concavity and convexity patterns on the cam surfaces relating to the direction of action can be made as like. A pressure adjusting means 36 can adjust the pressing force acting on the leading end 32a of the torque spring 32 in like manner as the pressing force adjusting means 16 in the example 1.

[0037] Fig. 5 shows shapes of the sinker 31 and the torque spring 32 constructing the movable sinker 30, and shapes of the base board 24 and the needle plate 25 constructing the needle bed 23, shown in Figs. 4..

Reference Signs List

[0038]

1, 21 Flatbed knitting machine
2, 22 Needle bed gap
3, 23 Needle bed
4, 24 Base board
5, 25 Needle plate
10, 30 Movable sinker
11, 31 Sinker
12, 32 Torque spring
13 Torque spring control cam
13a, 33a Biasing cam surface
14 Open/close control cam
14a, 34a Open/close cam surface
16, 36 Pressing force adjusting means

Claims

1. A flatbed knitting machine (1, 21) equipped with movable sinkers (10, 30), in which a plurality of sinkers (11, 31) are provided to be arranged at a leading end side of a needle bed (3, 23) facing a needle bed gap (2, 22) in such a manner that
each sinker (11, 31):

having a support receive part (11a, 31 a), a function arm (11b, 31 b) curved and extending forward from the support receive part (11a, 31a) to the needle bed gap (2, 22) side, and a passive arm (11c, 31c) provided backward at a side apart from the needle bed gap (2, 22) relative to the function arm (11b, 31 b), and the support receive part (11a, 31 a) supported on the needle bed (3, 23) in the vicinity of the needle bed gap (2, 22) in a manner capable of rocking displacement;
having a torque spring (12, 32) extending to a leading end (12a, 32a) while a portion between the function arm (11b, 31b) and the support receive part (11a, 3 1 a) set to a base end (12b, 32b) of the torque spring (12, 32) and capable of biasing the function arm (11c, 31c) in a direction in which the function arm (11c, 31c) advances into the needle bed gap (2, 22); and

being capable of switch over between a closed state where the function arm (11c, 3 1 c) advances into the needle bed gap (2, 22) and an opened state where the function arm (11c, 3 1 c) retreats from the needle bed gap (2, 22), by a sinker cam (13, 14; 33, 34) mounted on a carriage reciprocating along the needle bed (3, 23),

characterized in that
the leading end (12a, 32a) of the torque spring (12, 32) protrudes to an outward of the needle bed (3, 23), the sinker cam (13, 14; 33, 34) comprises:

a biasing cam surface (13a, 33a) having concavity and convexity in a direction in which pressing force is made to act on the leading end (12a, 32a) of the torque spring (12, 32); and
an open/close cam surface (14a, 34a) that controls opened and closed states of the sinker (11, 31) with concavity and convexity acting on the passive arm (11c, 31c) of the sinker (11, 31), under such a phase relation that:

the biasing cam surface (13a, 33a) is switched to the convexity and the open/close cam surface (14a, 34a) is switched to concavity in the closed state of the sinker (11, 31);
the biasing cam surface (13a, 33a) is switched to the concavity and the open/close cam surface (14a, 34a) is switched to the convexity in the opened state of the sinker (11, 31); and

the sinker cam (13, 14; 33, 34) switches the sinker(11, 31):

into the opened state when feeding of a knitting yarn is received by a knitting needle that has advanced into the needle bed gap (2, 22); and
into the closed state when the knitting needle which has received the knitting yarn is drawn to the needle bed (3, 23).

2. The flatbed knitting machine (1, 21) equipped with the movable sinkers(10, 30) according to Claim 1, further comprising a pressing force adjusting means (16, 36) that changes a position of said biasing cam surface (13a, 33a) of said sinker cam (13, 14; 33, 34) in a direction in which said pressing force is made to act so as to adjust the pressing force of said torque spring (12, 32) on said leading end (12a, 32a) in said closed state of said sinker (11, 31).

3. The flatbed knitting machine (1) equipped with the movable sinkers (10) according to Claim 1 or 2, wherein
said leading end (12a) of said torque spring (12) protrudes to said forward relative to said support receive part (11a) of said sinker (11), and
said passive arm (11c) of the sinker (11) protrudes to said backward relative to the support receive part (11a), and
said sinker cam (13, 14) is provided to be divided into:

a torque spring control cam (13) on which said biasing cam surface (13a) is formed at a position facing the leading end (12a) of the torque spring (12), and
an open/close control cam (14) on which said open/close cam surface (14a) is formed at a position facing the passive arm (11c) of the sinker (11).

4. The flatbed knitting machine (21) equipped with the movable sinkers (30) according to Claim 1 or 2, wherein
said passive arm (31c) of said sinker (31) bifurcates from a position between said function arm (31b) and said support receive part (31a) so as to protrude in an upward direction of floating from the needle bed (23),
said leading end (32a) of said torque spring (32) protrudes upward from a position apart to said backward relative to the passive arm (31c),
said sinker cam (33, 34):

has said biasing cam surface (33a) and said open/close cam surface (34a) that are opposed to each other at said backward and said forward respectively at an interval,
so as to accommodate the leading end of the passive arm (31c) of the sinker (31) and the leading end (32a) of the torque spring (32) between the open/close cam surface (34a) and the biasing cam surface (33a).

Fig.1

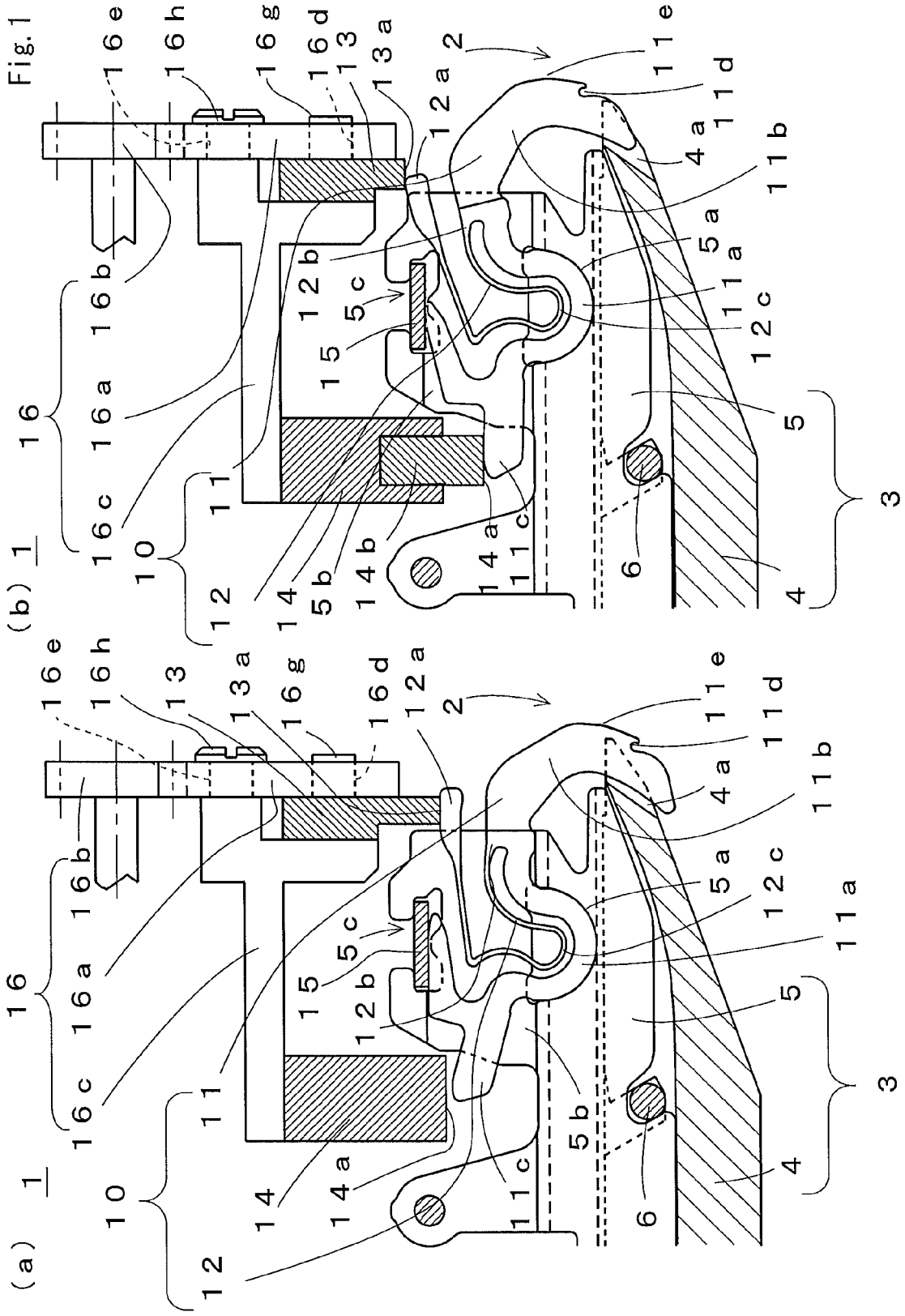

(a) 1
(b) 1
2
3
4
5
6
10
11
11a
11b
11c
11d
11e
12
12a
12b
12c
13
13a
14
14a
14b
15
16
16a
16b
16c
16d
16e
16g
16h
4a
5a
5b
5c

Fig. 2

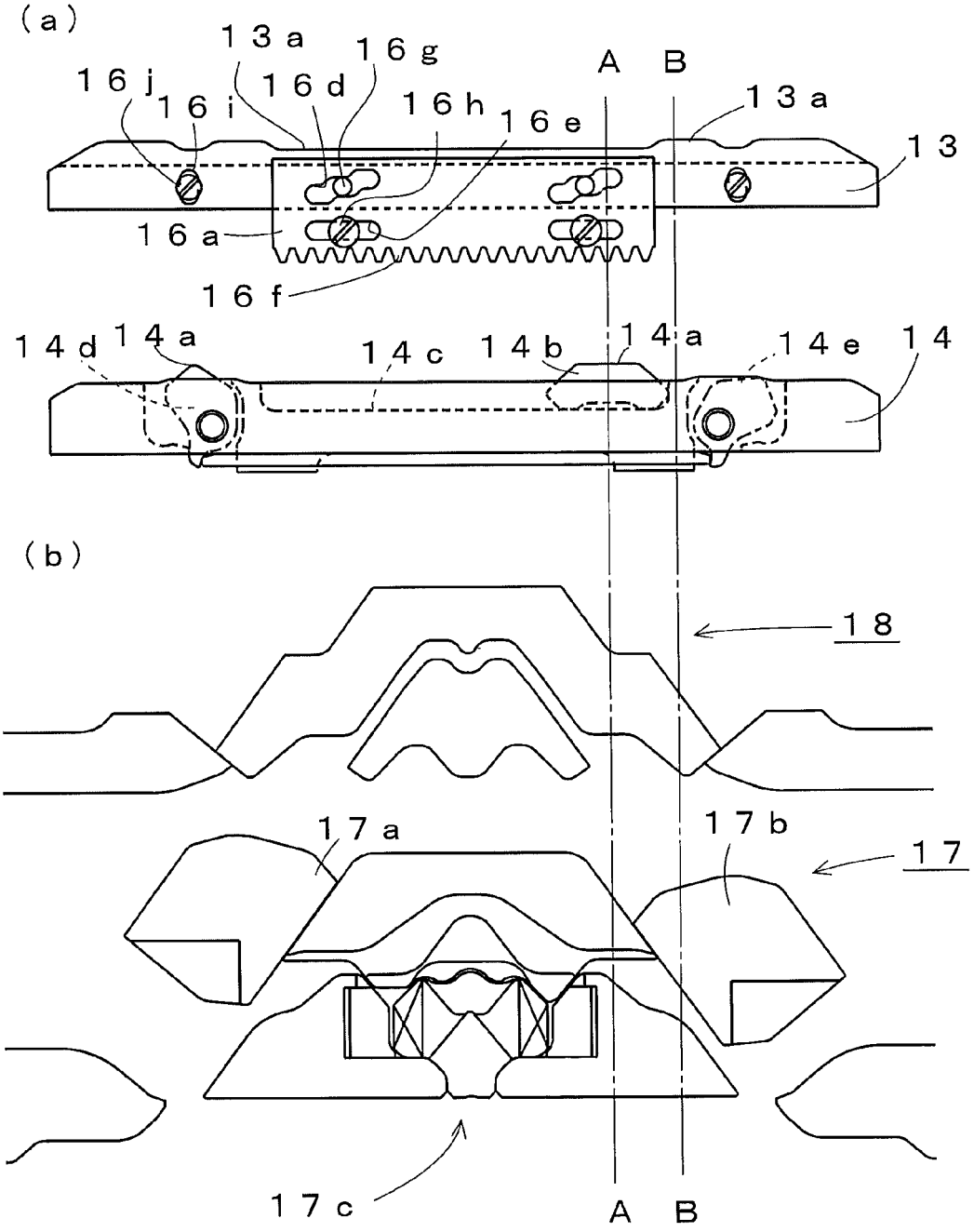

(a)
13a
16g
16j
16i
16d
16h
16e
A
B
13a
13
16a
16f
14d
14a
14c
14b
14a
14e
14
(b)
18
17a
17b
17
17c
A
B

Fig. 3

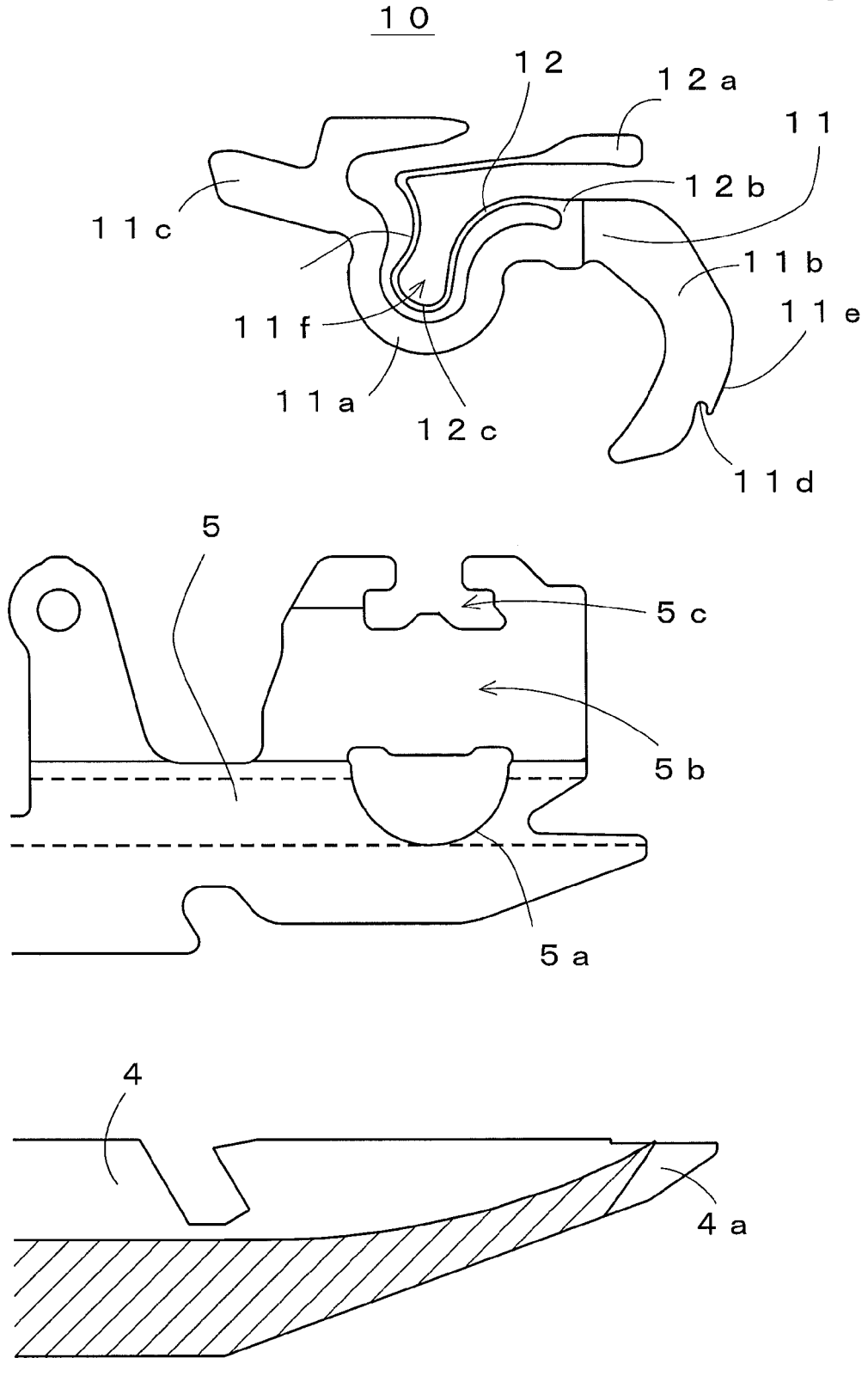


Fig. 4

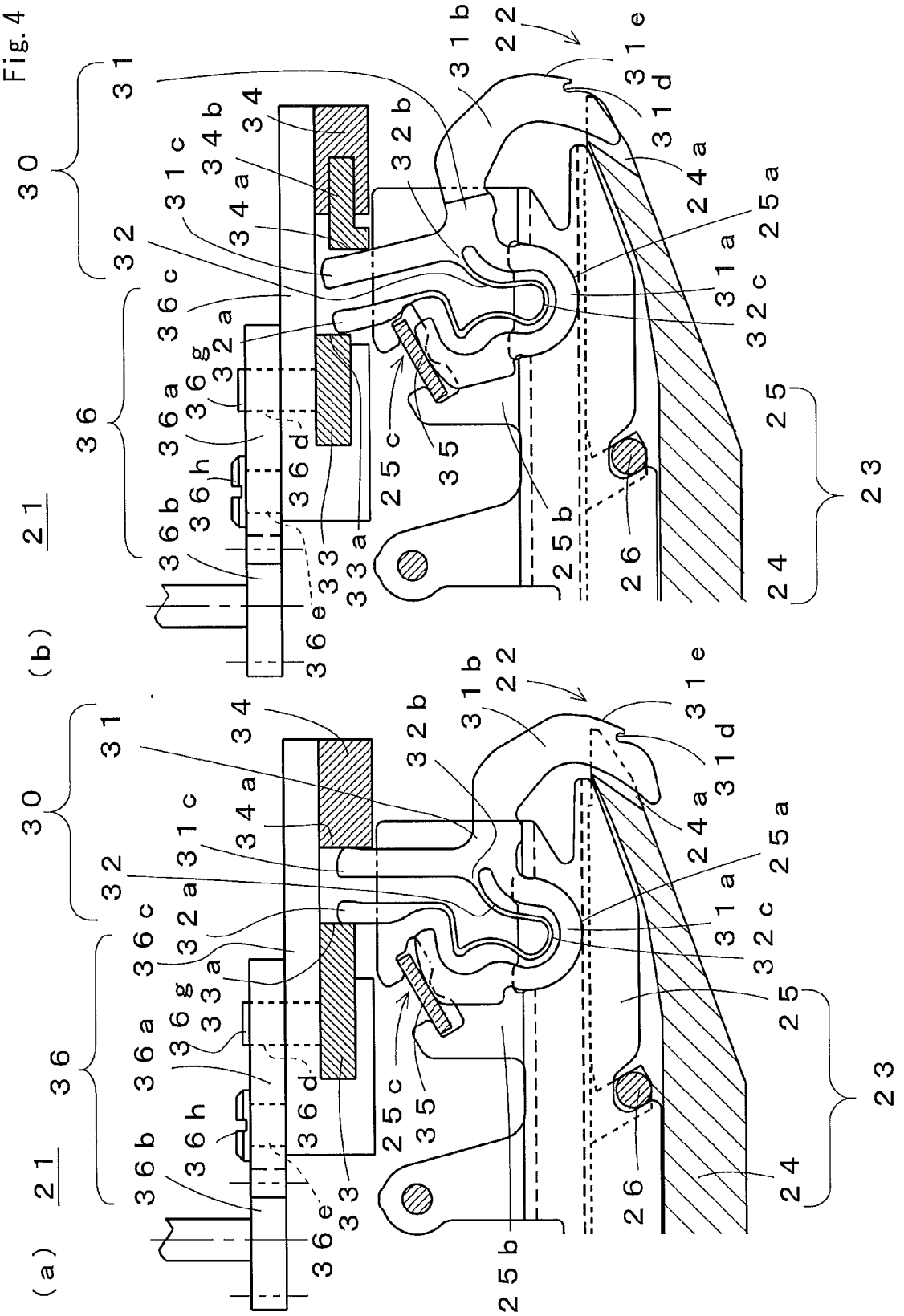
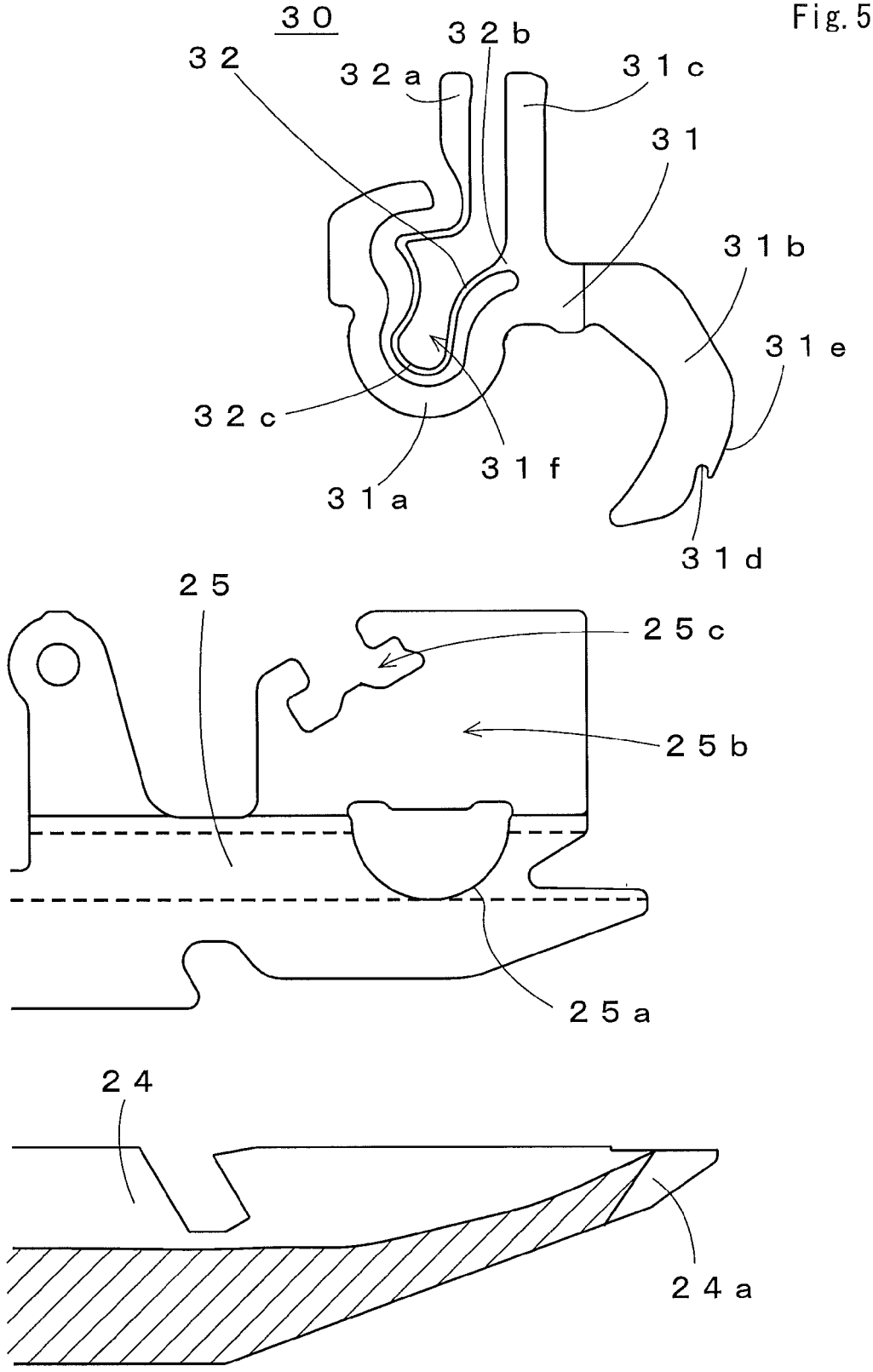


Fig. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 14 02 0048

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Y,D	EP 0 602 622 A1 (SHIMA SEIKI MFG [JP]) 22 June 1994 (1994-06-22) * column 6, line 20 - column 7, line 41; figures 2, 5, 7, 9 *	1,3,4	INV. D04B15/06 D04B15/36
X	DE 39 17 934 A1 (SCHIEBER UNIVERSAL MASCHF [DE]) 14 December 1989 (1989-12-14)	2	
Y	* column 4, lines 58-62; figures 8-11 * * column 7, lines 22-40 *	1,3,4	

TECHNICAL FIELDS SEARCHED (IPC)

D04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 May 2014	Kirner, Katharina

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