(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 483 317 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.05.2019 Bulletin 2019/20

(21) Application number: **18190364.2**

(22) Date of filing: **23.08.2018**

(51) Int Cl.:
D03D 47/12 *(2006.01)* ***D03D 41/00*** *(2006.01)*
D03D 47/16 *(2006.01)* *D03D 47/25* *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **10.11.2017 JP 2017217223**

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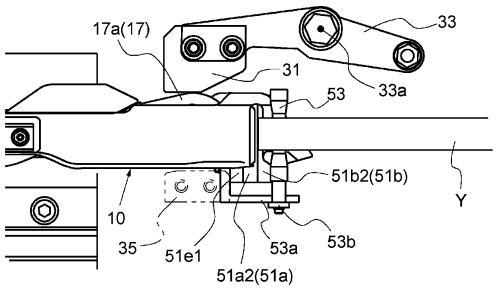
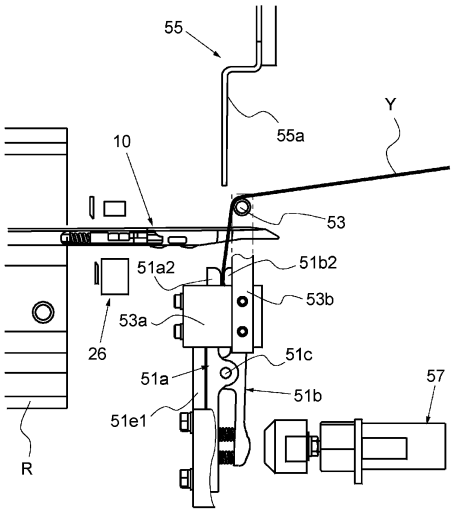
(54) **WEFT INSERTION DEVICE FOR RAPIER LOOM**

(57) A weft insertion device (1) includes a yarn guide mechanism (50) that includes a holding device (51) including a holding body that is disposed below the movement path (P) and holds a flat yarn (Y), a guide device (55) that is disposed above the holding device (51) and guides a tip portion of the flat yarn (Y) to the holding device (51), and a guide member (53) that guides the flat yarn (Y) at a position above the movement path (P). The guide device (55) includes a guide plate (55a) that is disposed directly above the holding body so as to be perpendicular to a weaving width direction and a guide-plate driving device (55g) that displaces the guide plate (55a) between an upper standby position above the movement path (P) and a guide position where an end of the guide plate (55a) reaches the holding body.

FIG. 11





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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a weft insertion device for a rapier loom that performs weaving by using a tape-shaped flat yarn as a weft. In particular, the present invention relates to a single-rapier weft insertion device with which a rapier head, whose standby position is set on a side opposite to a weft supply side, advances toward the weft supply side, grips the flat yarn on the weft supply side, and inserts the flat yarn as a weft while retreating, the weft insertion device including a yarn guide mechanism that holds the flat yarn on the weft supply side so that the flat yarn before being gripped by the rapier head is guided from a position above a movement path of the rapier head to a position below the movement path with respect to an up-down direction.

2. Description of the Related Art

[0002] In order to enable weaving by using a tape-shaped flat yarn as a weft, a rapier loom having a weft insertion device that is capable of performing weft insertion by using such a flat yarn is known to date. When inserting a flat yarn as a weft, it is necessary that weft insertion be performed so that twisting or the like of the flat yarn does not occur. Examples of a weft insertion device for realizing such weft insertion include a weft insertion device disclosed in Japanese Unexamined Patent Application Publication No. 2012-046835 (Patent Document 1).

[0003] The weft insertion device disclosed in Patent Document 1 is a single-rapier weft insertion device with which a rapier head, whose standby position is set on the side opposite to the weft supply side, is advanced toward the weft supply side, the rapier head grips a weft on the weft supply side, and the weft (flat yarn) is inserted while the rapier retreats. A rapier loom including such a single-rapier weft insertion device is called a "single-rapier loom".

[0004] In order that weft insertion can be performed so that twisting or the like of the flat yarn does not occur as described above, it is necessary that the flat yarn before being gripped by the rapier head on the weft supply side be guided at a position that is the same as the movement position of the rapier head in the front-back direction of the loom (the direction in which the warp T extends) so that the flat yarn extends parallel to the weft insertion direction (weaving-width direction) in plan view in a state in which a surface thereof (referred to as "a flat surface" in Patent Document 1) is facing in the up-down direction. Moreover, in order that the rapier head can grip the flat yarn in this state, it is necessary that the flat yarn be guided near the most advanced position of the rapier head in such a way that a part of the flat yarn near the tip of the flat yarn extends from a position above the movement path of the rapier head to a position below the movement path in the up-down direction.

[0005] A yarn guide mechanism for guiding the flat yarn in this way is disclosed also in Patent Document 1. The yarn guide mechanism described in the Patent Document 1 includes a yarn-tip clamping portion that clamps and holds a tip portion of the flat yarn and a weft support portion that guides the flat yarn on the upstream side (the weft supply package side) relative to the yarn-tip clamping portion.

[0006] The yarn clamping portion of the yarn guide mechanism disclosed in Patent Document 1 includes a fixed clamping piece that extends in the front-back direction below the movement path of the rapier head so as to include the movement position of the rapier head and a movable clamping piece that extends in the front-back direction in the same way as the fixed clamping piece and that is provided so as to contact or separate from the fixed clamping piece in the up-down direction. The yarn clamping portion is a mechanism that clamps a tip portion of the flat yarn in the up-down direction. The weft support portion has an angular U-shape that is elongated in the front-back direction and is capable of supporting the flat yarn at an upper position or a lower position.

[0007] In the rapier loom described in Patent Document 1, including the yarn guide mechanism structured as described above, at the time when the rapier head grips the flat yarn, the rapier head is located directly above the yarn clamping portion (the movable clamping piece), and, during weft insertion, the flat yarn is pulled out so that the flat yarn extends above the yarn clamping portion (the movable clamping piece). Moreover, with the yarn guide mechanism described in Patent Document 1, when the rapier head moves rearward (during weft insertion), the movable clamping piece of the yarn clamping portion is displaced upward and the weft support portion is displaced downward. Accordingly, with the yarn guide mechanism, the flat yarn that is being inserted as a weft is placed on an upper surface of the movable clamping piece of the yarn clamping portion while the movable clamping piece is displaced, and the flat yarn is pushed downward on the upstream side relative to the yarn clamping portion while the weft support portion is displaced downward. Patent Document 1 describes that, due to the displacements of the movable clamping piece and the weft support portion, the flat yarn slides off an upper surface of the movable clamping piece to a position on the fixed clamping piece (between the fixed clamping piece and the movable clamping piece).

[0008] However, the yarn guide mechanism described in Patent Document 1 has the following problems.

[0009] First, with the yarn guide mechanism described in Patent Document 1, as described above, during weft insertion, the flat yarn is placed on the movable clamping piece (pushed upward by the movable clamping piece) and the flat yearn is pushed downward by the weft support portion. In this case, the entirety of the flat yarn,

including a portion used to form a fabric, is pulled out while sliding over the surfaces of the movable clamping piece and the weft support portion. Moreover, during weft insertion, the flat yarn is pulled out at high speed, and the tension of the flat yarn is high. When the flat yarn is pushed upward by the movable clamping piece and pushed downward by the weft support portion as described above, the tension of the flat yarn is further increased. Therefore, sliding resistance between the flat yarn and the movable clamping piece and the weft support portion increases. As a result, the flat yarn may become damaged, and the quality of a woven fabric may decrease.

[0010] Moreover, regarding the yarn guide mechanism described in Patent Document 1, it is expected that the flat yarn slide off the movable clamping piece to a position on the fixed clamping piece. However, during weft insertion, the tension of the flat yarn is high as described above, and the sliding resistance between the flat yarn and the movable clamping piece is high. Moreover, even after the weft insertion, the tension of the flat yarn is maintained in order to prevent loosening of the flat yarn woven into the fabric. In this case, the flat yarn does not necessarily slip off the upper surface of the movable clamping piece, and it may occur that the flat yarn continues to be placed on the movable clamping piece until the flat yarn is cut after beating, and it may become impossible to grip the flat yarn. That is, the yarn guide mechanism described in Patent Document 1 lacks certainty (reliability) in holding of the flat yarn (preparation for the next weft insertion).

SUMMARY OF THE INVENTION

[0011] The present invention relates to a weft insertion device for a rapier loom for performing insertion of a flat yarn as a weft, the weft insertion device including a yarn guide mechanism described above, and an object of the present invention is to provide a weft insertion device in which a yarn guide mechanism is structured so that holding of the flat yarn can be more reliably performed without damaging the flat yarn.

[0012] As describe above, the present invention is based on a weft insertion device for a rapier loom that performs weaving by using a tape-shaped flat yarn as a weft, the weft insertion device being a single-rapier weft insertion device with which a rapier head, whose standby position is set on a side opposite to a weft supply side, advances toward the weft supply side, grips the flat yarn on the weft supply side, and inserts the flat yarn as a weft while retreating, the weft insertion device including a yarn guide mechanism that holds the flat yarn on the weft supply side so that the flat yarn before being gripped by the rapier head is guided from a position above a movement path of the rapier head to a position below the movement path with respect to an up-down direction. The present invention has the following features in the weft insertion device on which the present invention is based.

[0013] The yarn guide mechanism includes a holding device that includes a holding body that is disposed at a position of a gripping portion of the rapier head that has reached a most advanced position with respect to a weaving-width direction, the position being located below the movement path with respect to the up-down direction, the holding body receiving a tip portion of the flat yarn from above and holding the tip portion; a guide device that is disposed above the holding device and that guides the tip portion of the flat yarn to the holding device; and a guide member that guides the flat yarn at a position above the movement path and that is fixed in position with respect to the up-down direction. The guide device includes a guide plate that has a thin plate-like shape and that is disposed directly above the holding body of the holding device in such a way that a plate surface thereof is perpendicular to the weaving width direction, and a guide-plate driving device that displaces the guide plate between two positions, which are an upper standby position that is above the movement path and a guide position where an end of the guide plate reaches the holding body.

[0014] In the weft insertion device according to the present invention, the holding body may be configured to grip the flat yarn with a pair of holding portions, and the holding body may be composed of a first holding member that includes one of the pair of holding portions and whose position is fixed with respect to the weaving-width direction and a second holding member that includes the other of the pair of holding portions, the other of the holding portions being capable of contacting or separating from the one of the holding portions; and the holding device may include a grip-driving device that drives the second holding member so as to change a position of the other of the holding portions relative to the one of the holding portions.

[0015] Moreover, in the weft insertion device according to the present invention, the holding body of the holding device may be displaceable in a horizontal direction that is perpendicular to the weaving-width direction, and the holding device may include a displacement-driving device that displaces the holding body in accordance with an advance of the rapier head toward the most advanced position.

[0016] In the weft insertion device according to the present invention, the yarn guide mechanism is structured to hold the flat yarn, which is guided by the guide member at a position above the movement path of the rapier head, by using the holding device that is disposed below the movement path and that receives the flat yearn from above, and thereby the flat yarn is guided from a position above the movement path to a position below the movement path in the up-down direction. The position of the guide member with respect to the up-down direction is fixed, and the guide member does not actively apply a force upward or downward to the flat yarn during weft insertion. Moreover, the holding device is disposed so as not to interfere with the flat yarn after releasing the flat yarn for weft insertion (during weft insertion). Accord-

ingly, with the structure, damage to the flat yarn due to sliding contact between the flat yarn and the guide member or the holding device during weft insertion can be reduced as far as possible.

[0017] Moreover, the yarn guide mechanism includes a guide device that is disposed directly above the holding body of the holding device, and the guide device is structured so that the guide plate is displaced toward the holding body. The standby position of the guide plate is above the movement path. Accordingly, with this structure, the tip portion of the flat yarn on the weft supply side, which has been separated from a portion of the flat yarn inserted as a weft by being cut after beating, is guided toward the holding body by the guide plate, because the guide plate, which is located above the flat yarn, is displaced toward the holding body, which is located below the flat yarn. Accordingly, with this structure, the tip of the flat yarn is guided into the holding portion of the holding body with high accuracy, and the flat yarn can be held (guided) with high reliability for the next weft insertion.

[0018] In the yarn guide mechanism according to the present invention, when the holding body of the holding device is composed of the first and second holding members, the tip of the flat yarn can be held more securely. When the holding device further includes the grip-driving device for driving the second holding member, the tip of the flat yarn can be easily inserted into a space between the pair of holding portions, for gripping the flat yarn, without applying a load to the flat yarn.

[0019] In the yarn guide mechanism according to the present invention, when the holding device is structured so that the holding body is displaced in the direction described above in accordance with an advance of the rapier head toward the most advanced position, interference between the rapier head and the flat yarn can be prevented.

[0020] To be specific, in the weft insertion device for the rapier loom on which the present invention is based, the flat yarn that is guided by the yarn guide mechanism on the weft supply side is located at a position the same as the movement position of the rapier head in the front-back direction. The rapier head approaches the flat yarn that is guided by the yarn guide mechanism from the front side, the flat yarn is guided into the gripping portion of the rapier head, and the rapier head grips the flat yarn.

[0021] In this case, for example, even when the rapier head is structured to receive the flat yarn into the gripping portion from the front side as with the weft insertion device disclosed in Patent Document 1, depending on the structure of the rapier head, the rapier head may interfere with the flat yarn that is guided by the yarn guide mechanism. This is because, the rapier head, which advances toward the most advanced position at high speed, may not stop strictly at the most advanced position and may overrun slightly due to inertia or the like.

[0022] Examples of a rapier head having a different structure include a rapier head that has a gripping portion that is open toward a side and that receives the flat yarn into the gripping portion from the side. A rapier head having such a structure may have a leading end portion that is configured to guide the flat yarn toward the side. In the case of a weft insertion device structured in this way, the leading end portion of the rapier head and the flat yarn guided by the yarn guide mechanism interfere with each other, and, while the rapier head advances further, the flat yarn is guided toward an opening in the gripping portion, and thereby the flat yarn is guided into the gripping portion.

[0023] As described above, in some cases, the weft insertion device on which the present invention is based and with which the flat yarn is guided at the same position as the movement position of the rapier head in the front-back direction, is configured so that the rapier head interferes with (or is highly likely to interfere with) a portion (gripped portion) of the flat yarn gripped by the rapier head, while the rapier head advances toward the most advanced position. Even if the gripped portion is damaged due to the interference, the quality of the fabric is not directly affected, because the gripped portion of the flat yarn is to be located outside the fabric after weft insertion. However, because the flat yarn receives an impact due to the interference, depending on a structure for guiding the flat yarn on the weft supply side in the rapier loom or the type of the yarn, the interference may not be preferable.

[0024] In contrast, by structuring the holding device so that the holding body is displaced as described above, due to the displacement of the holding body, the flat yarn that is held by the holding body is also displaced, and thereby it is possible to displace the flat yarn to a position where the flat yarn does not interfere with the rapier head. Accordingly, by structuring the holding device in this way, the present invention can be applied to a rapier loom for which the interference is not preferable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Fig. 1 shows partially sectional plan views of a rapier head of a weft insertion device according to an embodiment of the present invention;

Fig. 2 is a perspective view of the rapier head of the weft insertion device according to the embodiment of the present invention;

Figs. 3A and 3B illustrate an opening operation, on the weft supply side, of a gripping mechanism of the rapier head of the weft insertion device according to the embodiment of the present invention;

Figs. 4A and 4B illustrate an opening operation, on the side opposite to the weft supply side, of the gripping mechanism of the rapier head of the weft insertion device according to the embodiment of the present invention;

Fig. 5 is a front view of a yarn supply mechanism, including a yarn guide mechanism, of the weft inser-

tion device according to the embodiment of the present invention;

Fig. 6 is a front view of the yarn supply mechanism, including the yarn guide mechanism, of the weft insertion device according to the embodiment of the present invention;

Fig. 7 is a front view of a holding device the yarn guide mechanism of the weft insertion device according to the embodiment of the present invention;

Figs. 8A and 8B are respectively a front view and a side view of a displacement-driving device of the yarn guide mechanism of the weft insertion device according to the embodiment of the present invention;

Figs. 9A and 9B are respectively a front view and a side view of a guide-plate driving device of the yarn guide mechanism of the weft insertion device according to the embodiment of the present invention;

Fig. 10 illustrates an operation of the yarn supply mechanism, including the yarn guide mechanism, of the weft insertion device according to the embodiment of the present invention;

Fig. 11 illustrates an operation of the yarn supply mechanism, including the yarn guide mechanism, of the weft insertion device according to the embodiment of the present invention;

Fig. 12 is a schematic plan view illustrating a region near a weft insertion device for a rapier loom to which the weft insertion device according to the present invention is applied; and

Figs. 13A to 13D are plan views of a rapier head of a weft insertion device according to another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] Hereinafter, referring to Figs. 1 to 12, a weft insertion device for a rapier loom according to an embodiment of the present invention will be described.

[0027] Fig. 12 schematically illustrates a single-rapier loom on which the present invention is based. The single-rapier loom is a rapier loom that performs weft insertion by using a single rapier head 10. In the present embodiment, a weft insertion device 1, which includes the rapier head 10, is a band-rapier weft insertion device that uses a band (rapier band) as a driving member that is used to reciprocally drive (reciprocate) the rapier head 10. Accordingly, the weft insertion device 1 includes a driving device in addition to the rapier head 10. The driving device includes a rapier band 21, to which the rapier head 10 is attached, and a band wheel 23, on which the rapier band 21 is looped and which rotates the rapier band 21 in normal and reverse directions in a predetermined angular range so as to reciprocate the rapier band 21. With the weft insertion device 1, the band wheel 23 is rotated, and thereby the rapier head 10 is reciprocated via the rapier band 21. Fig. 12 illustrates a state in which a reed R is located at the most retreated position. As shown in Fig. 12, a movement position where the rapier head 10 moves by being reciprocated as described above is set near the most retreated position of the reed R with respect to the front-back direction of the loom (the direction in which the warp T extends).

[0028] The weft insertion device 1 includes a yarn supply mechanism 25 for supplying the weft Y to the rapier head 10 during weft insertion. The weft Y used in the present invention is a flat yarn that has a tape-like and that is made of, for example, carbon fiber. In the weft insertion device 1, the driving device and the like are disposed so that a standby position of the rapier head 10, where the rapier head 10 is disposed in a period other than a weft insertion period, is set on a side opposite to the weft supply side, on which the yarn supply mechanism 25 is disposed, with respect to the weaving-width direction.

[0029] With the weft insertion device 1, in a weft insertion period, when the reed R is located at the most retreated position, the rapier head 10 is driven to advance, and the rapier head 10 moves toward the weft supply side in a shed formed by the warp T. Then, when the rapier head 10 reaches the position of the yarn supply mechanism 25 on the weft supply side, the weft (flat yarn) Y is supplied to the rapier head 10. Subsequently, the rapier head 10 grips the supplied flat yarn Y, and the rapier head 10 is driven to retreat toward the aforementioned standby position while gripping the flat yarn Y. Thus, the flat yarn Y is inserted into the shed of the warp T (weft insertion is performed), the flat yarn Y is beaten by the reed R, and thereby a fabric is formed.

[0030] Figs. 1 and 2 illustrate an example of a rapier head (the rapier head 10) applied to a weft insertion device according to the present invention. The rapier head 10 is mainly composed of a head body 11. The head body 11 is fixed to the rapier band 21 via an attachment member 27, and thereby the rapier head 10 is attached to the rapier band 21. The head body 11 has a thin-plate-shaped base portion 11a and a head portion 11b that tapers toward an extreme end 11g. The head body 11 in integrally formed by coupling the base portion 11a and the head portion 11b via a coupling portion 11c so as to be separated from each other in the longitudinal direction of the rapier head 10.

[0031] Accordingly, the head body 11 has a space portion 11d between the base portion 11a and the head portion 11b. One side of the space portion 11d in the width direction of the rapier head 10 (a direction perpendicular to the longitudinal direction in plan view) is closed by the coupling portion 11c. That is, the head body 11 has the space portion 11d in an end portion thereof including the head portion 11b; and the space portion 11d is defined by three inner side surfaces, which are an end surface 11b1 of the head portion 11b facing the base portion 11a, a side surface of the base portion 11a facing the head portion 11b, and a side surface of the coupling portion 11c facing the inside of the head body 11. The space portion 11d is, in the end portion, open toward one side

in the width direction and in the up-down direction, and has an angular U-shape in plan view. The space portion 11d functions as a yarn inlet portion of the head body 11 into which the flat yarn Y is guided as described below.

[0032] In the head body 11, the head portion 11b has a shape such that the head portion 11b tapers toward the extreme end 11g in the width direction and in the thickness (height) direction of the rapier head 10 and the extreme end 11g is located on a side opposite to the coupling portion 11c relative to the center with respect to the width direction. The head body 11 has a side wall 11e and a pair of side walls 11f that extend upward from the base portion 11a. The side wall 11e is formed in a front portion of the base portion 11a (on the head portion 11b side with respect to the longitudinal direction) on a side opposite to the coupling portion 11c side with respect to the width direction. The side walls 11f are formed in a rear portion of the base portion 11a (on a side opposite to the head portion 11b side with respect to the longitudinal direction, hereinafter simply referred to as the "rear side") so as to face each other in the width direction. These side walls 11e and 11f are also integrally formed with the base portion 11a. The side walls 11f are coupled to each other via a rib, and the attachment member 27 described above fixes the head body 11 to the rapier band 21 in a region surrounded by the pair of side walls 11f and the rib. Moreover, a guide portion 12, for restricting the position of the rapier head 10 on the side opposite to the weft supply side as described below, is attached to one of outer side surfaces of the pair of side walls 11f.

[0033] The rapier head 10 has a yarn catch 13 for gripping the flat yarn Y, which has been guided into the yarn inlet portion 11d of the head body 11, in cooperation with the head portion 11b. The yarn catch 13 is displaceable in the head body 11 in the longitudinal direction. Therefore, the rapier head 10 has a guide body 14 for guiding displacement of the yarn catch 13.

[0034] The guide body 14 is a block-shaped member and has a rectangular guide groove 14a for guiding displacement of the yarn catch 13. The guide body 14 is fixed to the base portion 11a of the head body 11 with a plurality of screw members in a state in which the extension direction of the guide groove 14a coincides with the longitudinal direction.

[0035] The yarn catch 13 has a guide portion 13a that is guided by the guide groove 14a of the guide body 14. The guide portion 13a has a plate-like shape. The guide portion 13a has a rectangular shape when viewed in the thickness direction thereof. The dimension of the guide portion 13a in the longitudinal direction, which is the direction of the long sides, is sufficiently larger than the dimension of the guide portion 13a in the transversal direction, which is the direction of the short sides. The groove width of the guide groove 14a of the guide body 14 is substantially the same as the dimension of the guide portion 13a of the yarn catch 13 in the transversal direction so that the guide groove 14a can guide displacement of the yarn catch 13 in the longitudinal direction.

[0036] The yarn catch 13 has a gripping portion 13b for gripping the flat yarn Y and a receiving portion 13c for receiving an urging force for gripping the flat yarn Y. The gripping portion 13b is located at one end of the guide portion 13a in the longitudinal direction, and the receiving portion 13c is located at the other end of the guide portion 13a. The yarn catch 13 is a member in which the guide portion 13a, the gripping portion 13b, and the receiving portion 13c are integrally formed.

[0037] As viewed in the thickness direction, the receiving portion 13c of the yarn catch 13 protrudes from the guide portion 13a toward one side with respect to the transversal direction. Accordingly, when viewed in the thickness direction, the guide portion 13a and the receiving portion 13c of the yarn catch 13 have a substantially L-shape. Moreover, the receiving portion 13c has a dimension that is larger than that of the guide portion 13a with respect to the thickness direction. One side of the receiving portion 13c is flush with the guide portion 13a, and the other side of the receiving portion 13c protrudes from the guide portion 13a.

[0038] The gripping portion 13b has a dimension that is the same as that of the guide portion 13a with respect to the thickness direction, and protrudes toward both sides from the guide portion 13a with respect to the transversal direction. The dimension of the gripping portion 13b in the longitudinal direction is substantially the same as the dimension of the guide portion 13a in the transversal direction. The dimension of the gripping portion 13b in the transversal direction is substantially the same as the dimension of one of the inner side surfaces (the end surface 11b1), which defines the yarn inlet portion 11d of the head portion 11b of the head body 11, in the width direction.

[0039] Moreover, the yarn catch 13 has an engagement portion 13d between the guide portion 13a and the receiving portion 13c. To be more specific, the yarn catch 13 has the engagement portion 13d that protrudes toward the guide portion 13a from a part of the receiving portion 13c protruding from the guide portion 13a with respect to the thickness direction within a region of the guide portion 13a in the transversal direction. The protruding end of the engagement portion 13d has an arc-shaped surface. In the yarn catch 13, the engagement portion 13d is also integrally formed with the guide portion 13a and the receiving portion 13c.

[0040] The guide portion 13a of the yarn catch 13 is loosely fitted in the guide groove 14a of the guide body 14 so that the yarn catch 13 is displaceable in the head body 11 in the longitudinal direction. In this state, the yarn catch 13 is in an orientation such that the gripping portion 13b is located closer to the head portion 11b than the guide body 14 with respect to the longitudinal direction and the engagement portion 13d is located closer to the base portion 11a than the guide portion 13a with respect to the thickness direction. In this state, the yarn catch 13 is disposed in such a way that the position of the gripping portion 13b coincides with the position the end surface

11b1 of the head portion 11b with respect to the width direction (the gripping portion 13b completely faces the end surface 11b1 of the head portion 11b). In other words, the guide body 14 is disposed, with respect to the width direction, at the position such that the guide body 14 can guide the guide portion 13a of the yarn catch 13.

[0041] The rapier head 10 includes spring members for urging the yarn catch 13, which is disposed in the head body 11 as described above, toward the head portion 11b of the head body 11 with respect to the longitudinal direction. To be more specific, in the head body 11, a spring receiving member 15b is disposed on the base portion 11a at a position separated from the guide body 14 toward the rear side with respect to the longitudinal direction. The spring receiving member 15b is attached to the head body 11 via a holder 15c, which is fixed to one of the pair of side walls 11f of the head body 11, with a screw member. In the head body 11, compression springs 15a (in the example shown in the figures, two compression springs 15a) are disposed between the spring receiving member 15b and the receiving portion 13c of the yarn catch 13, which is disposed as described above.

[0042] With this structure, in the rapier head 10, the receiving portion 13c of the yarn catch 13 receives spring forces of the compression springs 15a, and the yarn catch 13 is urged toward the head portion 11b in the head body 11. Accordingly, in the rapier head 10, the gripping portion 13b of the yarn catch 13 is in a state (pressed-contact state) in which the gripping portion 13b (to be more specific, an end surface 13b1 of the gripping portion 13b facing the head portion 11b) is pressed against the end surface 11b1 of the head portion 11b, unless a force toward the rear side is not applied to the yarn catch 13. With the rapier head 10, the flat yarn Y, which has been guided into the yarn inlet portion 11d, is gripped by the gripping portion 13b of the yarn catch 13 in the press-contact state and the head portion 11b of the head body 11.

[0043] In the structure illustrated in the figures, the spring receiving member 15b and the receiving portion 13c of the yarn catch 13 have holes for receiving parts of the compression springs 15a. A groove is formed in the end surface 11b1 of the head portion 11b so that the head portion 11b can slightly receive a part of the end surface 13b1 of the gripping portion 13b of the yarn catch 13 in a state in which the gripping portion 13b is pressed against the head portion 11b as described above. The end surface 11b1 of the head portion 11b, which faces the base portion 11a of the head body 11 as described above, is a surface that faces in the retreating direction of the reciprocating motion of the rapier head 10. That is, the end surface 11b1 is an inner side surface that is one of the inner side surfaces defining the yarn inlet portion 11d as described above and that faces in the retreating direction of the rapier head 10.

[0044] The rapier head 10 includes an operation lever 17 for displacing the yarn catch 13, which is disposed in the head body 11 in the state described above. As with general rapier looms, the single-rapier loom on which the present invention is based has an opener for operating the gripping mechanism of the rapier head 10 (for opening the gripping mechanism) on each of the weft supply side and the side opposite to the weft supply side (the details of the opener will be described below). In addition, the operation lever 17 of the rapier head 10 according to the present embodiment has a first engagement portion 17a on the weft supply side, which engages with the opener on the weft supply side to open the gripping mechanism (to displace the yarn catch 13 (the gripping portion 13b)); and, independently from the first engagement portion 17a, a second engagement portion 17b on the side opposite to the weft supply side, which engages with the opener on the side opposite to the weft supply side to open the gripping mechanism. To be specific, the operation lever 17 is structured as follows.

[0045] The operation lever 17 is provided in the rapier head 10 in such a way that operation lever 18 is swingable in the width direction relative to the head body 11. The operation lever 17 has a support portion 17c that is supported by the base portion 11a of the head body 11. The support portion 17c has a shape (substantially rectangular shape) a part of which is cut out when viewed in the thickness direction. The dimension of the support portion 17c, which has the substantially rectangular shape, in the long-side direction is substantially the same as the dimension of a part of the base portion 11a that supports the operation lever 17 (the support portion 17c) in the width direction.

[0046] The operation lever 17 has the first engagement portion 17a and the second engagement portion 17b as described above. When the operation lever 17 is viewed in the thickness direction, the first engagement portion 17a extends, with respect to the long-side direction and a direction (a short-side direction) perpendicular to the long-side direction, in the short-side direction from one end portion of the support portion 17c in the long-side direction. When the operation lever 17 is viewed in the thickness direction, the second engagement portion 17b extends from the other end portion of the support portion 17c in the short-side direction toward a side opposite to the first engagement portion 17a. Accordingly, the operation lever 17 has a substantially Z-shape in plan view. The first engagement portion 17a of the operation lever 17 has a shape such that the first engagement portion 17a is curved at a middle portion thereof and extends in a direction at an obtuse angle slightly larger than a right angle relative to the support portion 17c. The second engagement portion 17b of the operation lever 17 also extends in a direction at an obtuse angle slightly larger than a right angle relative to the support portion 17c.

[0047] The operation lever 17 is swingably supported by the head body 11 (the base portion 11a) at one end portion of the support portion 17c in the long-side direction. Thus, the operation lever 17 is disposed on the head body 11 so as to be swingable in the width direction. The

operation lever 17 is supported by the head body 11 in such a way that the first engagement portion 17a is located on the head portion 11b side of the head body 11 relative to the support portion 17c and the second engagement portion 17b is located on the rear side relative to the support portion 17c. As a result, in the rapier head 10, the first engagement portion 17a and the second engagement portion 17b of the operation lever 17 are located at different positions with respect to the longitudinal direction, and the second engagement portion 17b is located on the rear side (the retreating direction when the rapier head 10 is reciprocated) relative to the first engagement portion 17a.

[0048] The support position where the operation lever 17 is supported on the base portion 11a (the swing center of the operation lever 17) is set at a position on the rear side relative to the guide body 14 and near the guide body 14 with respect to the longitudinal direction. The support position is set at a position, with respect to the width direction, such that the position of the support portion 17c substantially coincides with the position of the base portion 11a (the support portion 17c and the base portion 11a substantially completely overlap in plan view), when the operation lever 17 is in a state in which the long-side direction substantially coincides with the width direction.

[0049] Regarding the positional relationship between the operation lever 17 and the yarn catch 13, which is disposed as described above, in the head body 11, the positional relationship is such that, with respect to the up-down direction, the operation lever 17 is located below the guide portion 13a of the yarn catch 13 and at the same height as the engagement portion 13d. The positional relationship is such that, with respect to the longitudinal direction, the engagement portion 13d of the yarn catch 13 is located on the rear side relative to the support portion 17c of the operation lever 17.

[0050] Due to the support position of the operation lever 17 and the positional relationship between and the operation lever 17 and the yarn catch 13, in the head portion 11b, the support portion 17c of the operation lever 17 is located between the guide body 14 and the engagement portion 13d of the yarn catch 13 with respect to the longitudinal direction.

[0051] As described above, the support portion 17c of the operation lever 17 has a rectangular shape a part of which is cut out. To be specific, a portion of the support portion 17c in the longitudinal direction that faces the engagement portion 13d and a surrounding portion are slightly cut out in a substantially arc shape. Accordingly, the dimension of the portion of the support portion 17c in the short-side direction is slightly smaller that of the remaining portion.

[0052] As described above, the yarn catch 13 receives urging forces of the compression springs 15a toward the head portion 11b. In a normal state of the rapier head 10 in which the operation lever 17 is not engaged with the opener, the gripping portion 13b is pressed against the head portion 11b of the head body 11. That is, in the normal state, the position of the yarn catch 13 in the longitudinal direction is held by the compression springs 15a (the urging forces) at a position where the gripping portion 13b is pressed against the head portion 11b. Accordingly, the position of the engagement portion 13d with respect to the longitudinal direction is also held by the urging forces at a position corresponding to the position of the yarn catch 13. In this state, the position of the engagement portion 13d in the longitudinal direction is separated from the guide body 14 by a distance that is substantially the same as (slightly larger than) the dimension of the cutout portion of the support portion 17c of the operation lever 17 in the short-side direction.

[0053] Accordingly, swinging of the operation lever 17, which is swingably supported as described above, is restrained by the engagement portion 13d, whose position in the longitudinal direction is held by the urging forces, and the guide body 14, which is fixedly disposed in the head body 11 (the base portion 11a). In this state, the long-side direction of the support portion 17c of the operation lever 17 substantially coincides with the width direction. Accordingly, a part of each of the first engagement portion 17a and the second engagement portion 17b of the operation lever 17, which has an obtuse angle slightly larger than a right angle relative to the support portion 17c as described above, protrudes from the head body 11 (the base portion 11a) in the width direction.

[0054] In the rapier head 10 structured as described above, a cover member 11h is attached to the base portion 11a of the head body 11. The cover member 11h covers members that are disposed on the base portion 11a in plan view in a region extending from the rib to the yarn inlet portion 11d in the longitudinal direction. Accordingly, in the rapier head 10, the guide body 14, the spring receiving member 15b, the compression springs 15a, the guide portion 13a and the receiving portion 13c of the yarn catch 13, a part of the operation lever 17, and the like are disposed in a space between the base portion 11a and the cover member 11h in the up-down direction.

[0055] Next, referring also to Figs. 3A to 4B, an operation of opening the gripping mechanism (displacing the yarn catch 13) (hereinafter, referred to as "the opening operation") on each of the weft supply side and the side opposite to the weft supply side will be described.

[0056] Figs. 3A and 3B illustrate the opening operation on the weft supply side. Figs. 3A and 3B illustrate states in which the rapier head 10 has reached the most advanced position, after the rapier head 10 has been driven to advance from the standby position toward the weft supply side and has moved in the shed of the warp T. The most advanced position corresponds to the position of the yarn supply mechanism 25 on the weft supply side shown in Fig. 12. The rapier head 10 is reciprocated as described above and thereby moves in a direction parallel to the weaving-width direction. That is, in the weft insertion device 1, the rapier head 10 is reciprocated in a direction such that the longitudinal direction thereof co-

incides with the weaving-width direction. Accordingly, the width direction of the rapier head 10 coincides with the front-back direction of the loom (the direction in which the warp T extends).

[0057] The yarn supply mechanism 25 includes an opener 31 on the weft supply side as illustrated in the figures. The opener 31 is disposed, with respect to the up-down direction and the weaving-width direction, at a position such that the opener 31 can face the first engagement portion 17a of the operation lever 17 in the front-back direction in a state in which the rapier head 10 has reached the most advanced position. That is, the opener 31 is disposed at a position, with respect to the up-down direction, at the same height as the operation lever 17 (the first engagement portion 17a) of the rapier head 10 on the loom so that the position of the opener 31 overlaps the position of the first engagement portion 17a in a state in which the rapier head 10 has reached the most advanced position. In the weft insertion device 1 according to the present embodiment, the opener 31 on the weft supply side can be moved closer to or away from the operation lever 17 in a state in which the rapier head 10 has reached the most advanced position.

[0058] To be specific, the yarn supply mechanism 25 includes a support lever 33 that supports the opener 31. The support lever 33 is supported by a frame (not shown) of the loom via appropriate support means or the like. The support lever 33 is swingable in a horizontal plane around a support point 33a at substantially the center in the longitudinal direction thereof. The opener 31 is attached to one end portion of the support lever 33 relative to the support point 33a. The opener 31, which is attached to the support lever 33 in this way, is disposed so that the opener 31 can face the operation lever 17 of the rapier head 10 in the front-back direction as described above. To be more specific, the opener 31 is disposed so that a side surface of the opener 31 facing the movement position of the rapier head 10 can face a side surface 17a1 of the first engagement portion 17a (an outer side surface that intersects the width direction, hereinafter referred to as "the first engagement surface").

[0059] The support lever 33 is coupled to a drive mechanism (not shown), for swinging the support lever 33, at the other end portion relative to the support point 33a. The driving mechanism swings the support lever 33 so that the opener 31 attached to the support lever 33 is displaced between the following two positions: an operating position, which is set as an engagement position where the opener 31 engages with the first engagement portion 17a of the operation lever 17 of the rapier head 10; and a non-operating position, which is a position separated from the first engagement portion 17a with respect to the front-back direction. Thus, the opener 31 can be moved closer to or away from the operation lever 17 (the first engagement portion 17a) by using the support lever 33, which is swingable, and the driving mechanism that swings the support lever 33. The opener 31 is located at the non-operating position when the opening operation is not performed.

[0060] When performing weft insertion, the rapier head 10 is driven to advance to be in a state in which the rapier head 10 is at the most advanced position (hereinafter, also referred to as "the most advanced state"). As illustrated in Fig. 3A, at the time when the rapier head 10 has reached the most advanced position, the opener 31 is located at the non-operating position and faces the first engagement surface 17a1 of the first engagement portion 17a of the operation lever 17 of the rapier head 10. In this state, the support lever 33 is driven to swing by the driving mechanism. Thus, the opener 31 becomes displaced from the non-operating position toward the operating position, that is, displaced toward (approaches) the first engagement portion 17a in the front-back direction and becomes engaged with the first engagement surface 17a1 of the first engagement portion 17a. When the opener 31 has been displaced to the operating position, the first engagement portion 17a is pressed by the opener 31 toward the inside of the rapier head 10, and the operation lever 17 swings in the clockwise direction in Figs. 3A and 3B. As a result, as illustrated in Fig. 3B, the operation lever 17 swings by a predetermined amount.

[0061] When the opener 31 engages with the operation lever 17 as described above, the rapier head 10 receives a force in the front-back direction from the opener 31. Therefore, the yarn supply mechanism 25 according to the present embodiment includes a first restricting member 35 for preventing (restricting) displacement of the rapier head 10 in the front-back direction by receiving the force. The first restricting member 35 is disposed at a position, with respect to the front-back direction, on a side of the rapier head 10 opposite to the side on which the opener 31 is located, such that the first restricting member 35 is located adjacent to a side portion of the rapier head 10 in the most advanced state. The first restricting member 35 is disposed at a position, with respect to the weaving-width direction, such that the first restricting member 35 faces the side wall 11e of the head body 11 of the rapier head 10 in the most advanced state in the front-back direction. Accordingly, even when the rapier head 10 receives the aforementioned force from the opener 31, because the force is received by the first restricting member 35 via the side wall 11e of the head body 11, displacement of the rapier head 10 in the front-back direction is restricted by the first restricting member 35.

[0062] When the opener 31 engages with the first engagement portion 17a and the operation lever 17 is swung as described above, in accordance with the swing of the operation lever 17, the support portion 17c of the operation lever 17, which is rotatably supported by the head body 11 as described above, rotates around the support position toward the rear side in the longitudinal direction. Thus, the yarn catch 13, which includes the engagement portion 13d facing the support portion 17c at a position adjacent to the support portion 17c with re-

spect to the longitudinal direction, is pressed by the support portion 17c at the engagement portion 13d, and becomes displaced toward the rear side against the urging forces of the compression springs 15a. As a result, the gripping portion 13b, which has been pressed against the head portion 11b of the head body 11, becomes displaced toward the rear side, and a space is formed in the yarn inlet portion 11d between the head portion 11b and the gripping portion 13b. That is, the gripping mechanism of the rapier head 10 is opened (the opening operation is finished).

[0063] Figs. 4A and 4B illustrate the opening operation on the side opposite to the weft supply side. Fig. 4A illustrates a state in which the rapier head 10 is located at a position immediately in front of the standby position after the rapier head 10 has moved in the shed of the warp T by being driven to retreat from the most advanced position toward the standby position on the side opposite to the weft supply side. Fig. 4B illustrates a state in which the rapier head 10 has reached the standby position by being driven further rearward from the state shown in Fig. 4A (a state in which the rapier head 10 is located at the standby position, hereinafter, also referred to as "the standby state").

[0064] In the weft insertion device 1, an opener 41 on the side opposite to the weft supply side illustrated in the figures is fixedly disposed at the standby position on the side opposite to the weft supply side. To be more specific, the weft insertion device 1 includes a band guide 29 that guides movement of the rapier band 21 on the side opposite to the weft supply side. The band guide 29 is fixed to the frame of the loom on the side opposite to the weft supply side. The opener 41 is attached to the band guide 29. The opener 41 has a substantially rectangular shape, in plan view, such that the length thereof (dimension in the long-side direction of the rectangular shape) is sufficiently larger than the width thereof (dimension in the short-side direction of the rectangular shape). The opener 41 is disposed in an orientation such that the long-side direction thereof coincides with the weaving-width direction.

[0065] The opener 41 is disposed at a position, with respect to the up-down direction, at the same height as the second engagement portion 17b of the operation lever 17 of the rapier head 10. The opener 41 is disposed at a position, with respect to the front-back direction, such that an inner side surface 41a (a side surface adjacent to the movement position of the rapier head 10) is adjacent to the head body 11 (the side wall 11e) of the rapier head 10.

[0066] The opener 41 is disposed, with respect to the weaving-width direction, in such a way that an end surface 41b adjacent to the warp T is located at a position where the second engagement portion 17b of the operation lever 17 reaches before the rapier head 10, which is driven to retreat as described above, reaches the standby position.

[0067] As illustrated in the figures, in the present embodiment, when the rapier head 10 is in the standby state, the end surface 41b is located at substantially the same position as the extreme end 11g of the rapier head 10 with respect to the weaving-width direction. The opener 41 has a length such that the opener 41 extends to a position behind (in the retreating direction of the rapier head 10) the position of the second engagement portion 17b of the rapier head 10 in the standby state. Accordingly, when the rapier head 10 is in the standby state, the opener 41 is present, with respect to the weaving-width direction, in a region in which a part of the rapier head 10 from the extreme end 11g to a position on the rear side relative to the second engagement portion 17b is present. In the present embodiment, the rapier head 10 and the opener 41 are in a positional relationship such that, with respect to the weaving-width direction, the second engagement portion 17b of the rapier head 10 is located at substantially the central portion of the opener 41 in a state in which the rapier head 10 is located at the standby position.

[0068] With the structure and the position of the opener 41, when the rapier head 10 is driven to retreat and reaches the side opposite to the weft supply side, a side surface (an outer side surface that intersects the width direction, hereinafter, referred to as "a second engagement surface 17b1") of the second engagement portion 17b of the operation lever 17 of the rapier head 10 engages with the opener 41 (the inner side surface 41a).

[0069] A part of the inner side surface 41a of the opener 41 on the warp T side is inclined outward. That is, the outer side surface of the opener 41 is flat along the entirety thereof, and the width of the end surface 41b is smaller than the width of the central portion. The width of the end surface 41b of the opener 41 is such that, at the time when the second engagement portion 17b of the rapier head 10 that is driven to retreat reaches the position of the opener 41, the second engagement portion 17b, which protrudes from the head body 11 of the rapier head 10 as described above, engages with an inclined surface 41a' of the inner side surface 41a without colliding with the end surface 41 b.

[0070] Thus, while the rapier head 10 is retreating, at the time when the second engagement portion 17b reaches the position of the opener 41, as illustrated in Fig. 4A, the second engagement surface 17b1 of the second engagement portion 17b first engages with the inclined surface 41a' of the inner side surface 41a of the opener 41 (to be more specific, a part of the inclined surface 41a' adjacent to the end surface 41b). Subsequently, while the rapier head 10 is retreated further from the time of the first engagement, the second engagement surface 17b1 becomes displaced along the inclined surface 41a'. Accordingly, the engagement point between the second engagement portion 17b (the second engagement surface 17b1) and the side surface 41a (the inclined surface 41a') becomes displaced toward the head body 11 of the rapier head 10 with respect to the front-back direction. That is, while the rapier head 10 is

retreated, in the rapier head 10, the second engagement portion 17b of the operation lever 17 becomes displaced toward the head body 11 with respect to the width direction. Thus, the inclined surface 41a' of the opener 41 functions as a cam surface that displaces the second engagement portion 17b toward the head body 11 in accordance with displacement thereof relative to the rapier head 10 in the weaving-width direction.

[0071] Due to the displacement of the second engagement portion 17b, in the rapier head 10, the operation lever 17 swings in the clockwise direction in Figs. 4A and 4B. When the rapier head 10 retreats to a position such that the engagement point reaches the flat portion of the inner side surface 41a of the opener 41 (excluding the inclined surface 41a'), as illustrated in Fig. 4B, substantially the entirety of the second engagement portion 17b enters the inside of the head body 11 (the space between the base portion 11a and the cover member 11h), and the operation lever 17 is swung by a predetermined amount. When the operation lever 17 is swung in this way, as with the weft supply side described above, the gripping mechanism of the rapier head 10 is opened.

[0072] With the rapier head 10, the displacement amount of the yarn catch 13 toward the rear side (the opening amount when opening the gripping mechanism) is determined in accordance with the swing amount of the operation lever 17. In the present embodiment, the swing amount of the operation lever 17 due to engagement of the opener 41 with the operation lever 17 (the second engagement portion 17b) on the side opposite to the weft supply side is set smaller than the swing amount of the operation lever 17 (the first engagement portion 17a) due to engagement of the opener 31 and the operation lever 17 on the weft supply side.

[0073] Also on the side opposite to the weft supply side, a second restricting member 43 is disposed. The second restricting member 43 restricts displacement of the rapier head 10 in the front-back direction due to a force in the front-back direction that is applied to the rapier head 10 when the operation lever 17 (the second engagement surface 17b1 of the second engagement portion 17b) engages with the opener 41. The second restricting member 43 has a shape similar to that of the opener 41, faces the opener 41 in the front-back direction, and is disposed at substantially the same position as the opener 41 with respect to the weaving-width direction. The second restricting member 43 is disposed in such a way that, with respect to the front-back direction, the position of an inner side surface thereof (a surface facing the opener 41) substantially coincides with the position the outermost surface (outer side surface) of the guide portion 12 of the rapier head 10 in the width direction.

[0074] Moreover, in the rapier head 10, the outer side surface of the guide portion 12 extends to a position on the rear side relative the second engagement portion 17b of the operation lever 17 with respect to the longitudinal direction. Accordingly, when the rapier head 10 retreats to a position such that the second engagement portion 17b engages with the opener 41 as described above, the outer side surface of the guide portion 12 contacts the inner side surface of the second restricting member 43. Thus, when the operation lever 17 (the second engagement portion 17b) engages with the opener 41, even if a force in the front-back direction is applied to the rapier head 10 as described above, the force is received by the second restricting member 43, and therefore displacement of the rapier head 10 in the front-back direction is restricted by the second restricting member 43.

[0075] In the state in which the operation lever 17 has swung by a predetermined amount due to engagement of the second engagement portion 17b and the opener 41 as described above, with respect to the width direction, the entirety of the first engagement portion 17a is located inside the rapier head 10 relative to the outer side surface of the guide portion 12. That is, in the rapier head 10, the guide portion 12 has a size such that the guide portion 12 can be in such a state. As described above, in the rapier head 10, the second engagement portion 17b is located on the rear side relative to the first engagement portion 17a with respect to the longitudinal direction. Accordingly, the weft insertion device 1 is structured so that, while the rapier head 10 moves rearward to the standby position, the first engagement portion 17a and the second restricting member 43 do not interfere with each other.

[0076] Next, referring to Figs. 5 to 9B, a structure for supplying the flat yarn Y, which is a weft, to the rapier head 10 when the rapier head 10 is in the most advanced state and the function of the structure will be described. That is, heretofore, an example of a structure included in a weft insertion device of a single-rapier loom that inserts the flat yarn Y as a weft has been described. In order to enable the flat yarn Y to be supplied to the rapier head on the weft supply side, the weft insertion device, which inserts the flat yarn Y as a weft includes a yarn guide mechanism that guides the flat yarn Y from a position above the movement path of the rapier head to a position below the movement path in the up-down direction. Hereinafter, a yarn guide mechanism 50 according to the present embodiment will be described in detail. In the present embodiment, the yarn guide mechanism 50 is structured so that the flat yarn Y is guided into the yarn inlet portion 11d of the rapier head 10 due to the operation of the yarn guide mechanism

[0077] In the present embodiment, the yarn guide mechanism 50 is included in the yarn supply mechanism 25. The yarn guide mechanism 50 guides the flat yarn Y, which is suppled from yarn supply means (not shown) including a weft supply package, as follows: with respect to the weaving-width direction, the flat yarn Y is guided at the position of the yarn inlet portion 11d (hereinafter, also referred to as "the yarn supply position") when the rapier head 10 is in the most advanced state; and with respect to the up-down direction, the flat yarn Y is guided from a position above the movement path of the rapier head 10 (shown by an alternate long and short dash line P in Figs. 5 and 6) to a position below the movement path.

[0078] To be more specific, the yarn guide mechanism 50 includes a holding device 51 that holds the flat yarn Y at a position below the movement path P, a guide member 53 that guides the flat yarn Y at a position above the movement path P, a guide device 55 that guides the flat yarn Y toward the holding device 51, and a fluid-pressure cylinder 57 (such as an air cylinder) as a grip-driving device that switches the holding device 51 between a holding state and a non-holding state.

[0079] The holding device 51 includes a holding body that receives the flat yarn Y from above and holds a tip portion of the flat yarn Y. The holding body is structured like a clip as a whole and includes a holding member 51a on the base side (first holding member), which serves as a holding base when holding the flat yarn Y, and a holding member 51b on the movable side (second holding member), which is rotationally operated when holding the flat yarn Y. The holding members 51a and 51b are mainly composed of base portions 51a1 and 51b1, each of which has a substantially pyramidal shape, and have holding portions 51a2 and 51b2 at ends of the base portions 51a1 and 51b1 in the longitudinal direction. That is, the holding body includes a pair of the holding portions 51a2 and 51b2, and, the holding portion 51a2 is included in the holding member 51a on the base side, which is the first holding member, and the holding portion 51b2 is included in the holding member 51b on the movable side, which is the second holding member.

[0080] In the holding members 51a and 51b, the holding portions 51a2 and 51b2 have dimensions larger than those of the base portions 51a1 and 51b1 with respect to the width direction of the holding members 51a and 51b, and are respectively continuous with the base portions 51a1 and 51b1 at middle parts thereof. Accordingly, the holding members 51a and 51b each have a T-shape when viewed in the thickness direction thereof. In addition, the holding members 51a and 51b are coupled to each other via a pivot shaft 51c at attachment portions 51a3 and 51b3, which are formed at substantially the middle part of the base portions 51a1 and 51b1 in the longitudinal direction. In the state in which the holding members 51a and 51b are coupled to each other in this way, the holding members 51a and 51b face each other in the thickness direction, and the positions of the holding portions 51a2 and 51b2 coincide with each other in the longitudinal direction of the base portions 51a1 and 51b1. Accordingly, the holding portions 51a2 and 51b2 can be made to contact each other or separate from each other in the state in which the holding portions 51a2 and 51b2 are coupled to each other in this way.

[0081] Moreover, the holding body includes compression springs 51d (in the example shown in the figures, two compression springs 51d) that are interposed between the base portions 51a1 and 51b1 at a position on a side of the attachment portions 51a3 and 51b3 opposite to a side on which the holding portions 51a2 and 51b2 are disposed with respect to the longitudinal direction of the base portions 51a1 and 51b1. Accordingly, in the holding body, the holding portions 51a2 and 51b2 of the holding members 51a and 51b are pressed against each other by the spring forces of the compression springs 51d.

[0082] The holding device 51 includes a holding-body support mechanism 51e for supporting the holding body (the holding member 51a on the base side) on the loom. Fig. 7 illustrates an example of the holding-body support mechanism 51e. AS illustrated in the figure, the holding-body support mechanism 51e includes a support plate 51e1 to which the holding member 51a on the base side is attached. The holding member 51a on the base side is attached to the support plate 51e1 at a side surface of the base portion 51a1 opposite to a side surface facing the holding member 51b on the movable side.

[0083] The support plate 51e1 is formed by bending a plate material into an L-shape. That is, the support plate 51e1 includes a plate portion (one-side plate portion) on one side relative to the bent portion and a plate portion (the other-side plate portion) on the other side relative to the bent portion. The holding member 51a on the base side is attached to an inner side surface (a surface facing the other-side plate portion) of the one-side plate portion of the support plate 51e1 in such a way that the longitudinal direction of the base portion 51a1 is parallel to an end surface of the other-side plate portion. The support plate 51e1 has a shape such that, with respect to the longitudinal direction of the base portion 51a1 of the holding member 51a on the base side, which is attached to the support plate 51e1, the dimension of the other-side plate portion is smaller than that of the one-side plate portion, the positions of one end portions of the plate portions coincide with each other, and the one-side plate portion is extended relative to the other-side plate portion.

[0084] The holding-body support mechanism 51e includes a bracket 51e3 for supporting the support plate 51e1 so that the support plate 51e1 can be supported on the loom. The support plate 51e1 is attached to the bracket 51e3 at an outer surface of the other-side plate portion (a surface opposite to a surface facing the one-side plate portion).

[0085] The bracket 51e3 includes a plate-shaped support portion to which the support plate 51e1 is attached, and is formed in an L-shape as viewed in a direction parallel to the surface to which the support plate 51e1 of the support portion is attached. That is, the bracket 51e3 includes, in addition to the support portion, a base portion that extends in a direction perpendicular to the support portion and that supports the support plate 51e1 on the loom. The support plate 51e1 is attached to an outer surface of the support portion of the bracket 51e3 (a surface opposite to a surface facing the base portion). The support plate 51e1 is attached to the bracket 51e3 in such a way that the longitudinal direction of the base portion 51a1 of the holding member 51a on the base side coincides with the extension direction in which the support portion of the bracket 51e3 extends relative to the base portion.

[0086] The holding-body support mechanism 51e includes a guide mechanism, such as an LM guide, composed of a rail 51e6 and a block 51e5, whose displacement is guided by the rail 51e6. The rail 51e6 is supported by the frame of the loom via appropriate support means or the like. The rail 51e6 is fixedly disposed at a position that is below the movement path P in the up-down direction and that is at the yarn supply position in the weaving-width direction so as to extend in the front-back direction. The bracket 51e3, to which the support plate 51e1 is attached as described above, is attached to an upper part of the block 51e5 of the guide mechanism in an orientation such that the extension direction of the support portion thereof coincides with the up-down direction.

[0087] Thus, the holding member 51a on the base side, which is attached to the support plate 51e1 as described above, and the holding member 51b on the movable side, which is coupled to the holding member 51a, are disposed on the loom in a state in which the holding member 51a is supported by the holding-body support mechanism 51e in a state in which the longitudinal direction of the base portions 51a1 and 51b1 coincides with in the up-down direction. In the guide mechanism of the holding-body support mechanism 51e, the block 51e5 is allowed to be displaced in the extension direction of the rail 51e6, that is, in the front-back direction, but is not allowed to be displaced in other directions. Accordingly, the position of the holding member 51a (the holding member 51b), which is supported by the block 51e5 via the bracket 51e3 and the support plate 51e1, is fixed with respect to the weaving-width direction.

[0088] In the state in which the holding members 51a and 51b are disposed on the loom, the holding members 51a and 51b are located below the movement path P as described above. Due to the position of the holding-body support mechanism 51e (the rail 51e6) on the loom and the positional relationship between the holding member 51a on the base side and the holding-body support mechanism 51e (the rail 51e6) in a state in which the holding member 51a is attached to the support plate 51e1, the holding member 51a, which is provided on the loom as described above, is disposed in such a way that a surface of the holding portion 51a2 facing the holding member 51b on the movable side with respect to the weaving-width direction is located at the yarn supply position. Accordingly, a holding section 51h of the holding device 51, which is formed as the holding portions 51a2 and 51b2 of the holding members 51a and 51b are pressed against each other, are also located at the yarn supply position with respect to the weaving-width direction. Because the holding-body support mechanism 51e is supported by the frame of the loom via the guide mechanism described above, the holding members 51a and 51b are displaceable on the loom in the front-back direction.

[0089] The holding device 51 includes a displacement-driving device as a driving mechanism for displacing the holding-body support mechanism 51e in the front-back direction and for displacing the holding members 51a and 51b in the front-back direction. The holding-body support mechanism 51e includes a coupling member 51e7, and the coupling member 51e7 is attached to the outer surface of the support portion of the bracket 51e3. Moreover, the holding-body support mechanism 51e is coupled to the displacement-driving device via the coupling member 51e7.

[0090] Figs. 8A and 8B illustrate an example of the displacement-driving device. A displacement-driving device 51f illustrated in Figs. 8A and 8B includes a support shaft 51f3 that is fixedly disposed on the loom at a position above the guide member 53 so that an axis thereof is oriented in the weaving-width direction, and a plate-shaped drive lever 51f1 that is supported by the support shaft 51f3 via a bearing and swingable on the loom in the front-back direction. As illustrated in Fig. 8B, the drive lever 51f1 is substantially L-shaped as viewed in the thickness direction and supported by the support shaft 51f3 at one end thereof. The drive lever 51f1 is coupled to the coupling member 51e7 (the bracket 51e3) at the other end thereof. The drive lever 51f1 and the coupling member 51e7 are connected to each other via a coupler 51f4 including a spherical bearing or the like.

[0091] The displacement-driving device 51f includes a cam mechanism for swinging the drive lever 51f1. The cam mechanism includes a rotation shaft 51f6 that is parallel to the support shaft 51f3 on the loom, and a cam 51f2 that is attached to the rotation shaft 51f6 so as to be unrotatable relative to the rotation shaft 51f6 and supported by the rotation shaft 51f6. The rotation shaft 51f6 is coupled to appropriate driving means. The rotation shaft 51f6 (the cam 51f2) is rotated by the driving means so as to rotate once for each cycle of the loom (during a period in which the main shaft of the loom rotates once). For example, the driving means includes a drive shaft that is coupled to the main shaft of the loom and rotated by the main shaft; and a transmission mechanism that couples the drive shaft and the rotation shaft 51f6 to each other, that transmits rotation of the drive shaft to the rotation shaft 51f6, and that includes a pulley, a belt, and the like. The driving means may be a drive motor that is directly coupled to the rotation shaft.

[0092] As illustrated in Fig. 8B, in the state in which the cam 51f2 is supported by the rotation shaft 51f6 as described above, the cam 51f2 is disposed on the loom so that a part of the cam 51f2 overlaps the drive lever 51f1 as viewed in the thickness direction of the drive lever 51f1. In the example illustrated in the figures, the cam 51f2 is a groove cam (whose cam groove is not shown in the figures). A cam follower (not shown), which can be guided by the cam groove of the cam 51f2, is rotatably attached to a surface of a part of the drive lever 51f1 that overlaps the cam 51f2 and faces the cam 51f2.

[0093] Thus, the drive lever 51f1 of the displacement-driving device 51f is driven to swing as the cam 51f2 is rotated as described above, and the drive lever 51f1 performs one reciprocating swing motion in the front-back direction for each rotation of the cam 51f2. Because the

drive lever 51f1 is driven to swing in this way, the holding-body support mechanism 51e, which is coupled to the drive lever 51f1, and the holding members 51a and 51b, which are supported by the holding-body support mechanism 51e, are driven to be displaced in the front-back direction as described below in a weft insertion period.

[0094] The yarn guide mechanism 50 includes the guide member 53, which guides the flat yarn Y as described above, and the guide member 53 is also supported by the holding-body support mechanism 51e. To be specific, the guide member 53 is a roller-like (shaft-like) member and is supported by the support plate 51e1 of the holding-body support mechanism 51e via an attachment plate 53a and a support arm 53b. The attachment plate 53a is formed by bending a plate material into an L-shape. The attachment plate 53a is attached to an outer surface of the one side plate portion of the support plate 51e1 at a part thereof closer to one end than the bent portion. In the state in which the attachment plate 53a is attached to the support plate 51e1, a part of the attachment plate 53a closer to the other end portion than the bent portion is located above the other side plate portion of the support plate 51e1 on the loom.

[0095] The support arm 53b is an elongated plate-shaped member and is attached to the attachment plate 53a at one end portion thereof in the longitudinal direction in such a way that the support arm 53b extends upward from the other end portion of the attachment plate 53a on the loom. The guide member 53 is supported only at the other end portion of the support arm 53b. In the state in which the guide member 53 is supported, the guide member 53 is located above the movement path P with respect to the up-down direction. That is, the support arm 53b has a length such that the guide member 53 is disposed at such a position. The guide member 53 is disposed, with respect to the weaving-width direction, on a side opposite to the side on which the reed R is disposed relative the holding portion 51a2 of the holding member 51a on the base side.

[0096] As described above, the guide member 53 is supported by the holding-body support mechanism 51e, which supports the holding members 51a and 51 b. Accordingly, while the holding members 51a and 51b are driven to be displaced in the front-back direction as described above, the guide member 53 is displaced in the front-back direction in the same way. The holding members 51a and 51b and the guide member 53 are driven to be displaced, with respect to the front-back direction, between the following two positions: a reference position, which is a position overlapping the movement position of the rapier head 10; and a retreated position, which is separated from the movement position toward the cloth fell side. The holding members 51a and 51b and the guide member 53 are usually disposed at the reference position. During a period from the time when the rapier head 10 is started to be driven to advance for weft insertion to the time when the rapier head 10 reaches the most advanced position, the holding members 51a and 51b and the guide member 53 are located the retreated position. When the rapier head 10 reaches the most advanced position and the flat yarn Y is guided into the yarn inlet portion 11d, the holding members 51a and 51b and the guide member 53 are displaced toward the reference position.

[0097] The yarn guide mechanism 50 further includes the fluid-pressure cylinder 57, which is an example of a grip-driving device, as described above. The fluid-pressure cylinder 57 switches the holding device 51 between a holding state and a non-holding state. To be more specific, the fluid-pressure cylinder 57 switches the holding section 51h of the holding device 51 between a holding state, in which the holding portions 51a2 and 51b2 of the holding members 51a and 51 b are pressed against each other, and a non-holding state, in which the holding portions 51a2 and 51b2 are separated from each other and the holding section 51h is opened.

[0098] The fluid-pressure cylinder 57 is fixed to the frame of the loom via appropriate support means or the like. The fluid-pressure cylinder 57 is disposed in such a way that a pressing body 57b, which is attached to an end of a piston rod 57a, faces, in weaving-width direction, the base portion 51b1 of the holding member 51b on the movable side at the reference position with respect to the front-back direction. The fluid-pressure cylinder 57 faces, with respect to the up-down direction, an end portion (lower end portion) of the base portion 51b1 on a side opposite to the holding portion 51b2 side in the longitudinal direction thereof. Moreover, the fluid-pressure cylinder 57 is disposed in such a way that, with respect to the weaving-width direction, the pressing body 57b is separated from the holding member 51b when the fluid-pressure cylinder 57 is activated (when the piston rod 57a is retreated) and the pressing body 57b presses the lower end portion of the holding member 51b by a predetermined amount when the fluid-pressure cylinder 57 is deactivated (when the fluid-pressure cylinder 57 is advanced).

[0099] Accordingly, when the fluid-pressure cylinder 57 is activated, the lower end portion of the holding member 51b on the movable side is pressed as described above and becomes displaced against the spring forces of the compression springs 51d, and, as a result, the holding member 51b rotates around the pivot shaft 51c, which couples the holding members 51a and 51b, in a direction such that the holding portion 51b2 separates from the holding member 51a. That is, the fluid-pressure cylinder 57 rotates the holding member 51b on the movable side so that the position of the holding portion 51b2, which is pressed against the holding portion 51a2, is changed to a position that is separated from the holding portion 51a2. Thus, the holding portion 51a2 of the holding member 51a on the base side and the holding portion 51b2 of the holding member 51b on the movable side, which have been pressed against each other as described above (as shown in Fig. 5) are separated from each other (as shown in Fig. 6), and the holding section

51h is opened.

[0100] The yarn guide mechanism 50 further includes the guide device 55, which guides the flat yarn Y toward the holding device 51, as described above. As illustrated in the figures, the guide device 55 includes a guide member that is formed by bending a thin plate by substantially a right angle at two positions, and a part of the guide member between an end portion of the guide member and one of the bent portions closer to the end portion corresponds to a guide plate in the present invention.

[0101] Regarding the position of a guide plate 55a, the guide plate 55a is disposed, with respect to the weaving-width direction, in such a way that the entirety thereof is located at substantially the same position as the holding section 51h of the holding device 51. That is, the guide plate 55a is disposed directly above the holding body of the holding device 51 in such a way that a plate surface thereof is parallel to the front-back direction (the thickness direction perpendicular to the plate surface coincides with the weaving-width direction). An end edge 55a1 of the guide plate 55a (an end edge on a side opposite to the bent portion) extends horizontally at the lowest position of the guide plate 55a. The guide plate 55a is disposed, with respect to the front-back direction, so as to be located at substantially the same position as the position of the holding section 51h (the holding portions 51a2 and 51b2) when the holding device 51 is located at the reference position.

[0102] In the present embodiment, the guide plate 55a has a width (dimension in the direction in which the end edge 55a1 extends) that is substantially the same as the dimension of the holding portions 51a2 and 51b2 in the width direction of the holding members 51a and 51b. The guide plate 55a, which is disposed as described above, is attached to a guide plate support mechanism, including a supporting body 55b to which the guide plate 55a is fixed, and is supported in such a way that the guide plate 55a is coupled to a guide-plate driving device 55g, which is a driving mechanism for displacing the guide plate 55a in the up-down direction.

[0103] The guide plate support mechanism includes, in addition to the supporting body 55b, to which the guide plate 55a is fixed, a guide mechanism for guiding displacement of the guide plate 55a in the up-down direction. The guide mechanism, which is similar to a guide mechanism of the holding-body support mechanism 51e of the holding device 51, is a mechanism, such as an LM guide, composed of a rail 55e and a block 55d, whose displacement is guided by the rail 55e. The rail 55e is supported by a support frame 59 (only partially shown in the figures) for the yarn guide mechanism 50, which is fixedly disposed on the frame of the loom, via a support bracket 55f. The holding-body support mechanism 51e (the rail 51e6) of the holding device 51 described above is also supported by the support frame 59.

[0104] The rail 55e of the guide mechanism, which is supported as described above, is fixedly disposed at a position above the movement path P on the loom such that the guide plate 55a can be disposed as described above and the longitudinal direction of the rail 55e coincides with the up-down direction. Accordingly, the block 55d of the guide mechanism is displaceable on the loom in the up-down direction. In addition, the supporting body 55b, to which the guide plate 55a is fixed, is attached to the block 55d via a plate-shaped spacer 55c. Thus, the guide plate 55a, which is disposed as described above on the loom, is displaceable in the up-down direction.

[0105] The guide-plate driving device 55g includes a plate-shaped elevation lever 55g1 coupled to the supporting body 55b (the guide plate 55a) and a cam mechanism for driving to swing the elevation lever 55g1. The elevation lever 55g1 is supported by the support shaft 51f3 of the displacement-driving device 51f described above and is swingable on the loom in the up-down direction. That is, in the present embodiment, a shaft that supports the drive lever 51f1 of the displacement-driving device 51f is the same as a shaft that supports the elevation lever 55g1 of the guide-plate driving device 55g. The support shaft 51f3 is rotatably supported by the support frame 59.

[0106] A cam 55g2 of the cam mechanism of the elevation-driving device 55g is supported by the rotation shaft 51f6 of the cam mechanism of the displacement-driving device 51f described above so as to be relatively-unrotatably attached to the rotation shaft 51f6. That is, in the present embodiment, a shaft that rotates the cam 51f2 of the cam mechanism of the displacement-driving device 51f is the same as a shaft that rotates the cam 55g2 of the cam mechanism of the elevation-driving device 55g. Accordingly, the cam 55g2 of the cam mechanism of the elevation-driving device 55g is rotated in the same way as the cam 51f2 of the cam mechanism of the displacement-driving device 51f as described above. The rotation shaft 51f6 is also rotatably supported by the support frame 59.

[0107] The elevation lever 55g1 is disposed in such a way that the thickness direction thereof coincides with the weaving-width direction and the elevation lever 55g1 extends in the front-back direction. The elevation lever 55g1 is coupled to the supporting body 55b via a coupler 55g4, which includes a spherical bearing or the like, via one end portion thereof. The elevation lever 55g1 is rotatably supported by the support shaft 51f3 at a position closer to the other end portion than the center in the longitudinal direction and is swingable on the loom in the up-down direction as described above.

[0108] As illustrated in Fig. 9B, the cam 55g2, which is supported by the rotation shaft 51f6, is disposed on the loom in such a way that a part thereof overlaps a portion of the elevation lever 55g1 closer to the other end than a portion supported by a support shaft 51g3, as viewed in the thickness direction of the elevation lever 55g1. The cam 55g2 is a groove cam (whose cam groove is not illustrated), as with the cam 51f2 of the cam mechanism of the displacement-driving device 51f. A cam follower, which is guided by the cam groove of the cam

55g2, is attached to the other end portion of the elevation lever 55g1.

[0109] Because the cam follower of the elevation lever 55g1 is guided by the cam groove of the cam 55g2, the elevation lever 55g1 is restrained from freely swinging and is located at a swing position corresponding to the position of the cam follower in the cam groove. Thus, because the supporting body 55b is coupled to the elevation lever 55g1 via the coupler 55g4, the guide plate 55a, which is disposed so as to be displaceable in the up-down direction as described above, is supported at a position corresponding to the swing position of the elevation lever 55g1 with respect to the up-down direction.

[0110] With the structure of the elevation-driving device 55g, as the cam 55g2 is rotated, the elevation lever 55g1 performs one reciprocating motion in the up-down direction for each rotation of the cam 55g2. As a result, the guide plate 55a is driven so as to be displaced in the up-down direction between the following two positions: an upper standby position, where the end edge 55a1 of the guide plate 55a is located above the guide member 53; and a guide position, where the end edge 55a1 is located below the holding portion 51a2 of the holding member 51a on the base side of the holding device 51. When the guide plate 55a is in a standby state, which not an operating state in which guiding of the flat yarn Y to the holding device 51 is performed, the guide plate 55a is disposed at the upper standby position. When the guide plate 55a is in the operating state, the guide plate 55a is driven be displaced toward the guide position.

[0111] Operational effects of the weft insertion device 1 structured as described above, in particular, operational effects of the yarn guide mechanism 50 is as follows.

[0112] Fig. 5 illustrates a state when weft insertion has been finished. The flat yarn Y supplied from the yarn supply means (weft supply package) is deflected toward the movement path P by the guide member 53, and is pulled out in the weaving-width direction toward the side opposite to the weft supply side. The weft insertion device 1 includes a cutting device 26 for cutting the flat yarn Y, which has been inserted as a weft, between the yarn guide mechanism 50 and the reed R in the weaving-width direction.

[0113] The cutting device 26 illustrated in the figures is a cutting device that cuts the flat yarn Y while clamping the flat yarn Y. The cutting device 26 includes a cutting mechanism including a fixed blade 26a1 and a movable blade 26a2 and a clamping mechanism including a fixed clamping body 26b1 and a movable clamping body 26b2. The cutting device 26 is structured so that the movable blade 26a2 and the movable clamping body 26b2 are displaced together in the up-down direction. When the movable blade 26a2 and the movable clamping body 26b2 are not performing a cutting operation of cutting the flat yarn Y, the movable blade 26a2 and the movable clamping body 26b2 are disposed at positions that are separated upward from the fixed blade 26a1 and the fixed clamping body 26b1.

[0114] When weft insertion is finished, at a predetermined timing after finishing the weft insertion and before the next weft insertion is started, the movable blade 26a2 and the movable clamping body 26b2 of the cutting device 26 are driven, and the flat yarn Y is cut at the position of the cutting device 26. Thus, the flat yarn Y connected to the yarn supply means is cut off from the flat yarn Y that has been inserted as a weft. In this state, the tip portion of the flat yarn Y on the yarn supply means side is clamped by the fixed clamping body 26b1 and the movable clamping body 26b2 and held at the position.

[0115] In this state, as illustrated in Fig. 6, the fluid-pressure cylinder 57 is activated, and the holding section 51h of the holding device 51 is opened (the holding portion 51a2 and the holding portion 51b2 are separated from each other). Moreover, in the guide device 55, the guide plate 55a, which is located at the upper standby position, is driven to be displaced downward toward the guide position. Thus, the guide plate 55a, which is located above the flat yarn Y extending toward the yarn supply means, first engages with the flat yarn Y at the end edge 55a1. Before the guide plate 55a engages with the flat yarn Y, the movable clamping body 26b2 of the cutting device 26 is driven upward, and the flat yarn Y, which has been clamped by the fixed clamping body 26b1 and the movable clamping body 26b2, is released.

[0116] As the guide plate 55a moves further downward from the time when the guide plate 55a engages with the flat yarn Y, the guide plate 55a guides the flat yarn Y downward while rubbing the flat yarn Y with the end edge 55a1. When the guide plate 55a reaches the guide position, as illustrated in Fig. 6, the tip portion of the flat yarn Y is inserted into the holding section 51h of the holding device 51, which is opened (between the holding portion 51a2 and the holding portion 51b2). In this state, the guide plate 55a is driven to be displaced toward the upper standby position, and the fluid-pressure cylinder 57 is deactivated. Thus, in the holding device 51, the holding member 51b on the movable side is rotated by the spring forces of the compression springs 51d so that the holding portion 51b2 is displaced toward the holding member 51a on the base side (the holding portion 51a2), and the flat yarn Y is clamped and held by the holding portion 51a2 and the holding portion 51b2.

[0117] In this state, the flat yarn Y is guided (deflected) by the guide member 53, which is located above the movement path P and extends to a position below the guide member 53, and the tip portion of the flat yarn Y is held by the holding members 51a and 51b, which are disposed below the movement path P. That is, with the yarn guide mechanism 50 (the holding device 51), after weft insertion is finished and the flat yarn Y is cut by the cutting device 26 as described above, a portion of the flat yarn Y continuous with the tip portion is guided from a position above the movement path P to a position below the movement path P in the up-down direction. In this state, the holding members 51a and 51b of the holding device 51 and the guide member 53 are located, with

respect to the front-back direction, at the reference position that overlaps the movement position of the rapier head 10 where the flat yarn Y is inserted as a weft.

[0118] When the flat yarn Y, which has been inserted as a weft, is beaten by the reed R and the next shed of the warp T is formed, the rapier head 10 is started to be driven to advance for the next weft insertion. Accordingly, in the yarn guide mechanism 50, the support mechanism 51e of the holding device 51 is driven to be displaced so that the holding members 51a and 51b and the guide member 53, which are located at the reference position as described above, are displaced toward the retreated position in the front-back direction (a direction parallel to the width direction). Thus, as illustrated in Fig. 10, the holding members 51a and 51b and the guide member 53 are located at the retreated position, which is separated from the movement position of the rapier head 10 toward the cloth fell side in the front-back direction. At this time, the opener 31 on the weft supply side is located at the non-operating position as the support lever 33 is driven as described above.

[0119] When the rapier head 10 is driven to advance as described above and reaches the most advanced position, the rapier head 10 is located, in plan view, between the holding members 51a and 51b and the guide member 53 (and a portion of the flat yarn Y, which is guided in the up-down direction so as to extend between the guide member 53 and the holding members 51a and 51b) and the opener 31. In this state, as described above, the first engagement portion 17a of the operation lever 17 of the rapier head 10 (the first engagement surface 17a1) and the opener 31 face each other in the front-back direction, and the position of the yarn inlet portion 11d of the rapier head 10 and the position of the holding section 51h of the holding device 51 substantially coincide with each other in the weaving-width direction.

[0120] In this state, first, the support lever 33 is driven to swing and the opener 31 is displaced toward the operating position; and, as illustrated in the upper part of Fig. 11, the opener 31 engages with the operation lever 17 of the rapier head 10 (the first engagement surface 17a1 of the first engagement portion 17a). Thus, in the rapier head 10, the opening operation is performed, and the gripping mechanism is opened as described above. The yarn inlet portion 11d, which is formed as a space portion in the rapier head 10 (the head body 11), is closed to the outside when the gripping portion 13b of the yarn catch 13 is pressed against the head portion 11b of the head body 11 (when the gripping mechanism is closed). When the gripping mechanism of the rapier head 10 is opened as described above (when the opening operation is performed), the yarn inlet portion 11d is opened to the outside.

[0121] Then, in the state in which the gripping mechanism of the rapier head 10 (the yarn inlet portion 11d) is opened, in the holding device 51 of the yarn guide mechanism 50, the support mechanism 51e is driven to be displaced so that the holding members 51a and 51b and the guide member 53 are displaced toward the reference position with respect to the front-back direction. Accordingly, in the yarn guide mechanism 50, a portion of the flat yarn Y guided in the up-down direction as described above is displaced to a position that overlaps the rapier head 10 in the front-back direction. Thus, the portion of the flat yarn Y (to be precise, a part of the portion located at the same height as the rapier head 10 in the up-down direction) is guided into the yarn inlet portion 11d of the rapier head 10 that is opened as described above. Fig. 11 illustrates a state in which the flat yarn Y is guided into the yarn inlet portion 11d in this way.

[0122] When the flat yarn Y is guided into the yarn inlet portion 11d of the rapier head 10 in this way, the support lever 33 is driven to swing in a direction opposite to the aforementioned direction and the opener 31 is displaced toward the non-operating position, and the opener 31 is separated from the operation lever 17 of the rapier head 10 (the first engagement portion 17a) again. Thus, in the rapier head 10, the gripping portion 13b of the yarn catch 13 is pressed against the head portion 11b of the head body 11 again, and the flat yarn Y is gripped by the gripping portion 13b and the head portion 11b of the gripping mechanism.

[0123] In the yarn guide mechanism 50, the fluid-pressure cylinder 57 is activated again, and the holding section 51h of the holding device 51 is opened (the holding portion 51a2 and the holding portion 51b2 are separated from each other). Thus, the flat yarn Y, the tip portion of which has been held by the holding members 51a and 51b of the holding device 51, is released from the holding device 51.

[0124] After the flat yarn Y has been released from the holding device 51, the rapier head 10 is started to be driven to retreat, and the rapier head 10, which is holding the flat yarn Y with the gripping mechanism as described above, starts moving rearward toward the standby position. Thus, the tip portion of the flat yarn Y is pulled out from the inside of the holding section 51h of the holding device 51 (between the holding portion 51a2 and the holding portion 51b2), a portion of the flat yarn T connected to the yarn supply means is pulled out into the shed of the warp T as the rapier head 10 moves rearward, and thereby weft insertion is performed. When the tip portion of the flat yarn Y is pulled out from the holding section 51h, the fluid-pressure cylinder 57 is deactivated, the holding device 51 returns to a state before holding the flat yarn Y (before the tip portion of the flat yarn Y is inserted) again to prepare for the next weft insertion.

[0125] When the rapier head 10 is driven to retreat and reaches a position near the standby position, in the rapier head 10, the second engagement surface 17b1 of the second engagement portion 17b of the operation lever 17 engages with the opener 41 on the side opposite to the weft supply side, and the operation lever 17 is released from the gripping mechanism. Thus, the flat yarn Y is released from a state in which the leading end portion thereof is gripped by the rapier head 10. Subsequently,

when the rapier head 10 moves back to the standby position, one weft insertion is complete.

[0126] As heretofore described, in the yarn guide mechanism 50 of the weft insertion device 1 according to the present embodiment, the holding body of the holding device 51 for holding the flat yarn Y includes the pair of holding portions 51a2 and 51b2, which face each other in the weaving-width direction, and is disposed below the movement path P. The holding body is structured to receive (the tip portion of) the flat yarn Y from above into the holding section 51h between the pair of holding portions 51a2 and 51b2 and hold the flat yarn Y. With the holding body, which is capable of holding the flat yarn Y by receiving the flat yarn Y from above, after weft insertion has been finished and the flat yarn Y has been cut by the cutting device, the tip portion of the flat yarn Y on the weft supply side can be received into the holding section 51h. Accordingly, with the structure of the holding body, the flat yarn Y and the holding body can be completely separated from each other until the holding body holds the flat yarn Y. Thus, with the weft insertion device 1 including the yarn guide mechanism 50 structured as described above, sliding contact between the holding body and the flat yarn Y scarcely occurs, and therefore damage to the flat yarn Y due to sliding contact between the flat yarn Y and a member can be reduced as far as possible.

[0127] The yarn guide mechanism 50 includes the guide device 55 structured as described above, and, when guiding the tip portion of the flat yarn Y, after being cut, into the holding section 51h of the holding body, the tip portion of the flat yarn Y is guided by the guide plate 55a into the holding section 51h (between the holding portions 51a2 and 51b2). With this structure, the tip portion of the flat yarn Y can be more reliably guided into the holding section 51h to holding the flat yarn Y with the holding body.

[0128] The yarn guide mechanism 50 according to the present embodiment includes a grip-driving device (the fluid-pressure cylinder 57) for opening the holding section 51h of the holding body, which is structured as described above, to be in the non-holding state. With the structure of the holding body of the holding device 51 described above, the holding portion 51a2 and the holding portion 51b2 are elastically pressed against each other in the holding section 51h by using the spring forces of the compression springs 51d. Therefore, the guide plate 55a can be pressed into the space between the holding portions 51a2 and 51b2 without actively opening the holding section 51h, and thereby the tip portion of the flat yarn Y can be guided into the holding section 51h. Moreover, also during weft insertion, when the rapier head 10 grips and pulls the flat yarn Y, the tip portion of the flat yarn Y can be pulled out of the holding section 51h where the holding portions 51a2 and 51b2 are in pressed-contact with each other. However, if the tip portion of the flat yarn Y is pressed into the holding section 51h in the closed state or pulled out of the holding section 51h in the closed state, a load is applied to the flat yarn Y and the flat yarn Y may be damaged.

[0129] In contrast, by structuring the yarn guide mechanism 50 so that the grip-driving device is included and the holding section 51h of the holding body is actively opened when guiding the tip portion of the flat yarn Y and when starting weft insertion as described above, a load is not applied to the flat yarn Y when guiding the flat yarn Y into the holding section 51h and when pulling out the flat yarn Y from the holding section 51h. Accordingly, with such a structure, the yarn guide mechanism 50 can handle the flat yarn Y of any type.

[0130] Moreover, the holding device 51 of the yarn guide mechanism 50 according to the present embodiment includes the displacement-driving device, and the holding body is displaced in the front-back direction in accordance with the reciprocating motion of the rapier head 10. Even with a structure that is different from the structure of the present embodiment and in which the holding body is not driven to be displaced (for example, the rapier head disclosed in Patent Document 1), it may be possible to lead the flat yarn Y into a yarn inlet portion, for holding the flat yarn Y, of the rapier head. However, with this structure, the flat yarn Y and the rapier head interfere with each other or may interfere with each other. Such interference may not be preferable, depending on the type of the flat yarn Y.

[0131] In contrast, with the structure of the yarn guide mechanism 50 according to the present embodiment described above, before guiding the flat yarn Y into the yarn inlet portion 11d to hold the flat yarn Y in the rapier head 10, the rapier head 10 and the flat yarn Y do not interfere with each other, and therefore the yarn guide mechanism 50 can be used for weaving performed by a rapier loom of any type.

[0132] Heretofore, the weft insertion device according to an embodiment of the present invention the present invention (hereinafter, referred to as "the embodiment") has been described. However, the present invention is not limited to the embodiment, and may be realized in other embodiments (modifications) as described below.

[0133] (1) Regarding the yarn guide mechanism, in the embodiment, the yarn guide mechanism 50 includes the holding device 51 that holds the flat yarn Y below the movement path P, and the holding body of the holding device 51 for holding the flat yarn Y is composed of the holding member 51a on the base side (first holding member) and the holding member 51b on the movable side (second holding member) as described above. The yarn guide mechanism 50 according to the embodiment includes the fluid-pressure cylinder 57, which is a grip-driving device for actively switching the holding device 51 between the holding state and the non-holding state.

[0134] However, even in the case where the holding device of the yarn guide mechanism (the holding body) is structured as in the embodiment, in the present invention, a yarn guide mechanism need not have the grip-driving device (fluid-pressure cylinder) as in the embodiment. That is, in the yarn guide mechanism according

to the embodiment, the fluid-pressure cylinder 57 may be omitted.

[0135] To be specific, as described above, in the embodiment, the holding body is structured so that the holding portion 51b2 of the holding member 51b on the movable side is pressed against the holding portion 51a2 of the holding member 51a on the base side by the compression springs 51d. The grip-driving device is a device that displaces the holding portion 51b2 (the holding member 51b) so that the holding portion 51b2 separates from the holding portion 51a2 in order to facilitate insertion of the flat yarn Y into the space (the holding section 51h) between the holding portions 51a2 and 51b2. In addition, insertion of the flat yarn Y into the space between the holding portions 51a2 and 51b2 is performed by displacing the guide plate 55a of the guide device 55 downward to the space between the holding portions 51a2 and 51b2 as described above.

[0136] However, when inserting the flat yarn Y into the space between the holding portions 51a2 and 51b2 while guiding the flat yarn Y by using the guide plate 55a in this way, it is not necessary to actively open the holding section 51h with the grip-driving device as described above. Instead, it is possible to insert the flat yarn Y by moving the guide plate 55a downward and pressing the guide plate 55a into the space between the holding portions 51a2 and 51b2, because the holding portion 51b2 is displaced by the pressing force. Accordingly, in the yarn guide mechanism, the grip-driving device (the fluid-pressure cylinder 57 in the embodiment) for the holding device may be omitted.

[0137] (2) Regarding the holding device of the yarn guide mechanism, the holding body of the holding device 51 according to the embodiment is structured so that the two holding members 51a and 51b hold the flat yarn Y. However, the holding device of the yarn guide mechanism according to the present invention is not limited to a device having a holding body that mechanically holds the flat yarn Y in this way. For example, the holding device may have a holding body that holds the flat yarn Y by using a suctioning airflow, such as a suction pipe. The holding device may have a holding body having a combination of elastic members, such as a pair of plate springs. Also in these cases, as describe above in (1), the grip-driving device of the weft insertion device (yarn guide mechanism) is omitted.

[0138] (3) Regarding the yarn guide mechanism, in the embodiment, the holding body (the holding section 51h) of the holding device 51 is displaceable in the front-back direction, and a driving mechanism for displacing the holding body is included in the yarn guide mechanism. The yarn hold mechanism is structured so that, in order to prevent interference between the leading end portion of the rapier head 10 and the flat yarn Y when the rapier head 10 advances toward the most advanced position, before the rapier head 10 reaches the most advanced position, the yarn hold mechanism displaces the holding body and the guide member 53, which guides a portion of the flat yarn Y in the up-down direction in cooperation with the holding body and which is supported by the holding device 51, in the front-back direction. That is, the weft insertion device according to the embodiment is structured so that a portion of the flat yarn Y guided by a yarn guide mechanism in the up-down direction is actively displaced the front-back direction due to the displacement of the holding body and the guide member of the yarn guide mechanism before the rapier head 10 reaches the most advanced position.

[0139] However, in the weft insertion device according to the present invention, the yarn guide mechanism is not limited to the mechanism described above with which the holding body and the guide member, which guide the flat yarn Y in the up-down direction, are displaced in the front-back direction. Instead, the holding body and the guide member may be fixedly disposed at a predetermined position (the reference position) in the front-back direction. In this case, the flat yarn Y is guided into the yarn inlet portion of the rapier head is performed by corporation of guiding of the flat yarn Y in the up-down direction by the yarn guide mechanism and the reciprocating motion of a rapier head, by using a rapier head illustrated in Figs. 13A to 13D.

[0140] A rapier head 10' in the example illustrated in Figs. 13A to 13D differs from the rapier head 10 according to the embodiment in that a head portion 11b' is formed so that an extreme end 11g' is within a range of a coupling portion 11c' with respect to the width direction, that is, the extreme end 11g' is located, in the width direction, closer to the coupling portion 11c' than the yarn inlet portion 11d' (on a side of the yarn inlet portion 11d' opposite to the opening in the front-back direction). Although not illustrated, with respect to the front-back direction, the holding body and the guide member of the yarn guide mechanism are fixedly disposed at the reference position as described above. Accordingly, the flat yarn Y is guided in the up-down direction at the position. In Figs. 13A to 13D, Y' represents a part of a portion (hereinafter, referred to as "the guided portion") of the flat yarn Y guided in the up-down direction as described above, the part being located at the same height as the rapier head 10' in the guided portion.

[0141] With the structure illustrated in Figs. 13A to 13D, when the rapier head 10' is driven to advance and reaches a position near the most advanced position, as shown in Fig. 13A, an inclined surface at the leading end of the rapier head 10', which is inclined from the extreme end 11g' of the head portion 11b' toward the yarn inlet portion 11d', engages with the part Y' of the flat yarn Y. After the engagement, as the rapier head 10' further advances, as illustrated in Fig. 13B, the flat yarn Y (the part Y') is guided by the inclined surface of the rapier head 10', is displaced toward the rear side in the weaving-width direction relative to the rapier head 10', and is displaced toward the cloth fell side in the front-back direction (the direction parallel to the width direction).

[0142] As described above, the positions of the holding

body and the guide member of the yarn guide mechanism in the front-back direction are fixed. Therefore, as the part Y' of the guided portion of the flat yarn Y, which engages with the rapier head 10', is displaced as described above, the guided portion is bent at the engaging part Y' in front view.

[0143] Subsequently, as the rapier head 10' advances further, the flat yarn Y (the part Y') is further displaced as described above, and the flat yarn Y (the part Y') moves over a side edge of the head portion 11b' of the rapier head 10' opposite to the coupling portion in the width direction. Fig. 13C illustrates a state immediately before the flat yarn Y moves over the side edge. When the part Y' moves over the side edge of the head portion 11b' in this way, the guided portion of the flat yarn Y tries to return to the original state from the state in which the flat yarn Y is bent as described above due to the tension thereof, and thereby the part Y' is displaced in a direction away from the cloth fell in the front-back direction. As a result, the flat yarn Y (the part Y') is guided into the yarn inlet portion 11d' of the rapier head 10'.

[0144] As described above, in the example illustrated in Figs. 13A to 13D, the weft insertion device is structured so that, by cooperation of guiding of the flat yarn Y in the up-down direction by the yarn guide mechanism, the structure of the rapier head 10', and the advance of the rapier head 10', the flat yarn Y is displaced in the front-back direction while the rapier head 10' advances to the most advanced position, and the flat yarn Y is guided into the yarn inlet portion 11d' of the rapier head 10' after the displacement.

[0145] In the case where the weft insertion device is structured as described above, the guided portion of the flat yarn Y is bent while being guided by the inclined surface of the head portion 11b' of the rapier head 10' as described above. When the guide portion is bent, the tension of the guided portion increases. Therefore, in the case where the weft insertion device is structured as described above, in order to prevent the tension of the guided portion of the flat yarn Y from increasing excessively, it is preferable that the holding device of the yarn guide mechanism be structured to that the holding body thereof holds the flat yarn Y by using suction airflow as described above.

[0146] The weft insertion device according to the present invention is not limited to a device that is structured to use a rapier head of a type described in the embodiment or illustrated in Figs. 13A to 13D, and may be structured to use a rapier head of a type disclosed in Patent Document 1. In this case, the flat yarn is guided into the yarn inlet portion of the rapier head (weft gripping portion) as described in Patent Document 1.

[0147] (4) Regarding the openers for swinging the operation lever, in the embodiment, the opener 31 on the weft supply side is disposed so that the opener 31 can move closer to or away from the operation lever of the rapier head that has reached the most advanced position, and the opener 41 on the side opposite to the weft supply side is fixedly disposed at a position, with respect to the front-back direction, such that the opener 41 can engage with the operation lever of the rapier head.

[0148] However, in the weft insertion device according to the present invention, the opener on the weft supply side may be, as with the opener on the side opposite to the weft supply side according to the embodiment, fixedly disposed at a position such that the opener can engage with the operation lever of the rapier head with respect to the front-back direction. In the case where the rapier head is structured as in the embodiment, the operation lever engages with the fixedly-disposed opener at an outer side surface thereof that forms an acute angle relative to the advancing direction of the rapier head. Accordingly, with such a structure, compared with the existing structure such that the opener and the operation portion of the rapier head engage with each other at a surface perpendicular to the advancing direction of the rapier head, a force applied to the rapier head in a direction opposite to the advancing direction at the time of the engagement is small. Thus, with this structure, because buckling of the rapier band is less likely to occur (in particular, buckling is almost unlikely to occur when the rotation speed of the loom is low), even when the opener on the weft supply side is fixedly disposed as described above, a problem is not likely to occur.

[0149] In the embodiment, the opener on the side opposite to the weft supply side is fixedly disposed as described above. However, as with the opener on the weft supply side according to the embodiment, the opener on the side opposite to the weft supply side may be disposed so that that the opener can move closer to or away from the operation lever of the rapier head in the front-back direction. In addition, by using an appropriate driving mechanism, the opener may be driven to be displaced toward the rapier head (operation lever) when the operation lever of the rapier head, which is retreating toward the standby position, reaches a region where the opener is present with respect to the weaving-width direction.

[0150] (5) In the embodiment, the weft insertion device is a band-rapier weft insertion device that uses a band member as a driving member that reciprocates the rapier head. However, the present invention can be applied to a bar-rapier weft insertion device that uses a bar member as the driving member.

[0151] The present invention is not limited to any of the embodiments described above and may be modified in various ways within the spirit and scope of the present invention.

Claims

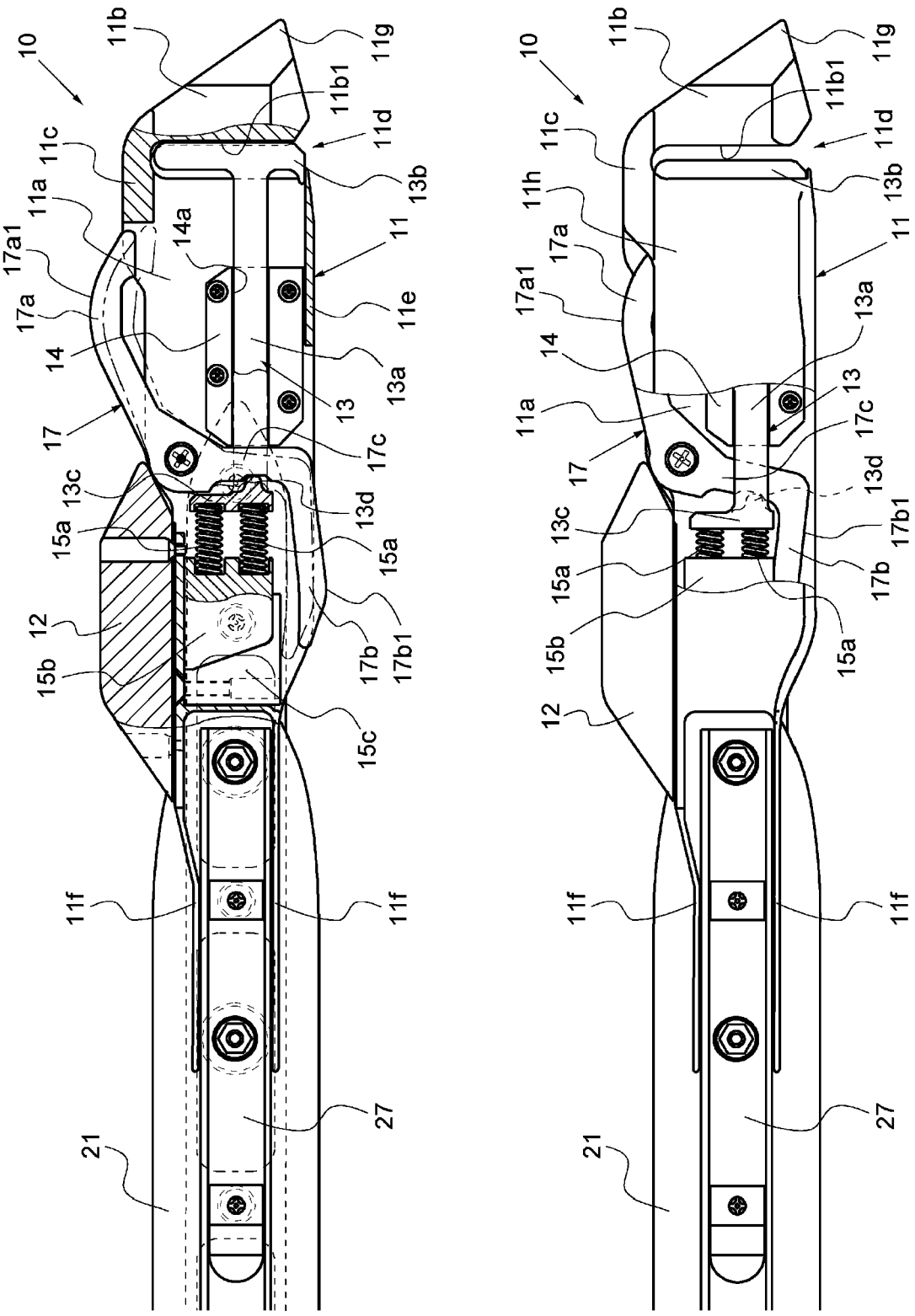
1. A weft insertion device (1) for a rapier loom that performs weaving by using a tape-shaped flat yarn (Y) as a weft, the weft insertion device (1) being a single-rapier weft insertion device with which a rapier head (10, 10'), whose standby position is set on a side

opposite to a weft supply side, advances toward the weft supply side, grips the flat yarn (Y) on the weft supply side, and inserts the flat yarn (Y) as a weft while retreating, the weft insertion device (1) including a yarn guide mechanism (50) that holds the flat yarn (Y) on the weft supply side so that the flat yarn (Y) before being gripped by the rapier head (10, 10') is guided from a position above a movement path (P) of the rapier head (10, 10') to a position below the movement path (P) with respect to an up-down direction,
wherein the yarn guide mechanism (50) includes a holding device (51) that includes a holding body that is disposed at a position of a gripping portion (13b) of the rapier head (10, 10') that has reached a most advanced position with respect to a weaving-width direction, the position being located below the movement path (P) with respect to the up-down direction, the holding body receiving a tip portion of the flat yarn (Y) from above and holding the tip portion; a guide device (55) that is disposed above the holding device (51) and that guides the tip portion of the flat yarn (Y) to the holding device (51); and a guide member (53) that guides the flat yarn (Y) at a position above the movement path (P) and that is fixed in position with respect to the up-down direction, and
wherein the guide device (55) includes a guide plate (55a) that has a thin plate-like shape and that is disposed directly above the holding body of the holding device (51) in such a way that a plate surface thereof is perpendicular to the weaving width direction, and a guide-plate driving device (55g) that displaces the guide plate (55a) between two positions, which are an upper standby position that is above the movement path (P) and a guide position where an end of the guide plate (55a) reaches the holding body.

2. The weft insertion device (1) for a rapier loom according to Claim 1,
wherein the holding body is configured to grip the flat yarn (Y) with a pair of holding portions (51a2, 51b2), and the holding body is composed of a first holding member (51a) that includes one of the pair of holding portions (51a2) and whose position is fixed with respect to the weaving-width direction and a second holding member (51b) that includes the other of the pair of holding portions (51b2), the other of the pair of holding portions (51b2) being capable of contacting or separating from the one of the holding portions (51a2), and
wherein the holding device (51) includes a grip-driving device (57) that drives the second holding member (51b) so as to change a position of the other of the holding portions (51b2) relative to the one of the holding portions (51a2).

3. The weft insertion device (1) for a rapier loom according to Claim 1 or 2,
wherein the holding body of the holding device (51) is displaceable in a horizontal direction that is perpendicular to the weaving-width direction, and the holding device (51) includes a displacement-driving device (51f) that displaces the holding body in accordance with an advance of the rapier head (10, 10') toward the most advanced position.

FIG. 1


10
11b
11g
11b1
11d
11c
11a
13b
17a1
14a
11
17a
11e
14
13a
13
17
17c
13c
13d
15a
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17b1
15b
15c
11f
11f
27
21
11h
13a
17c
17b1

FIG. 2

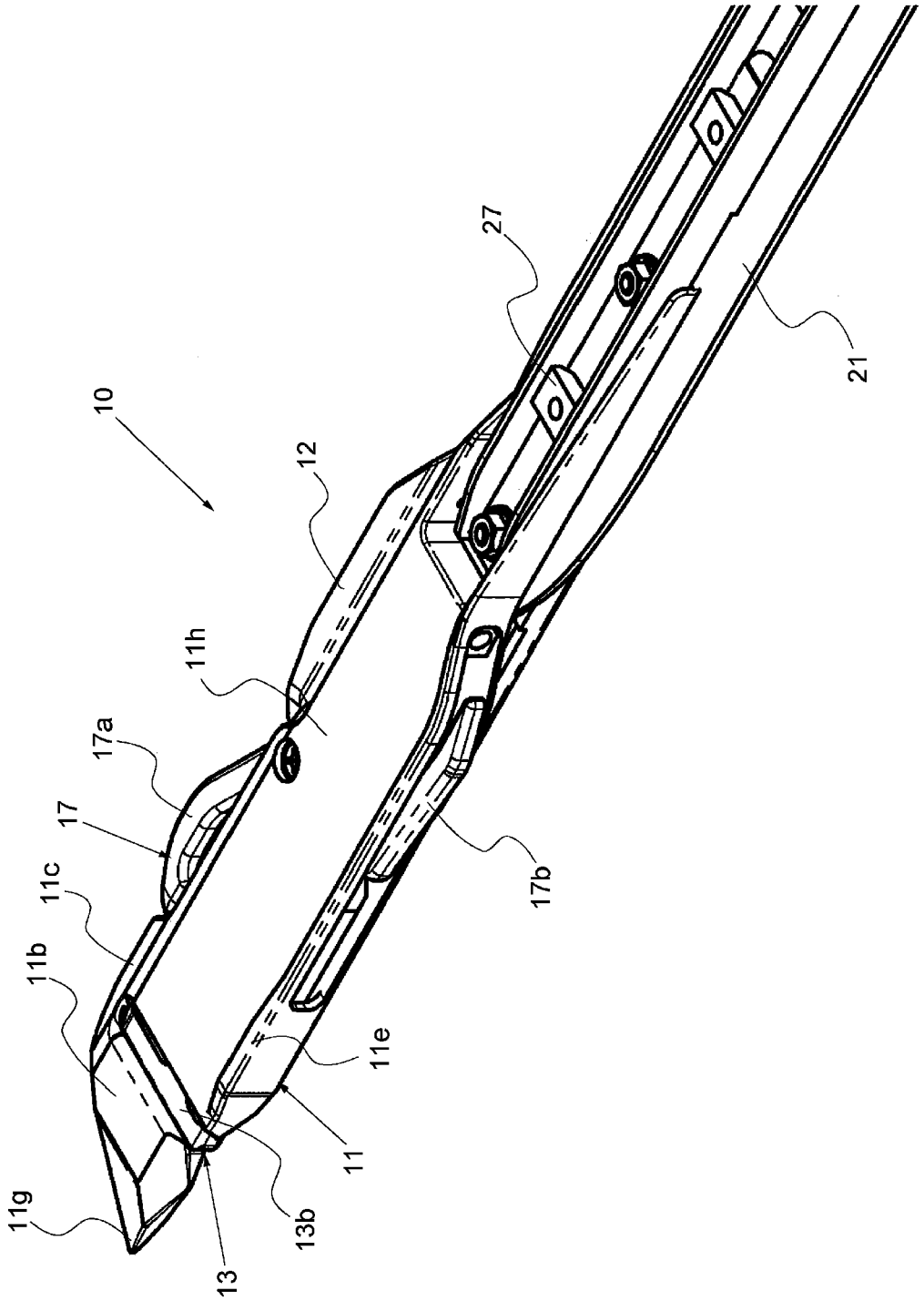


FIG. 3A

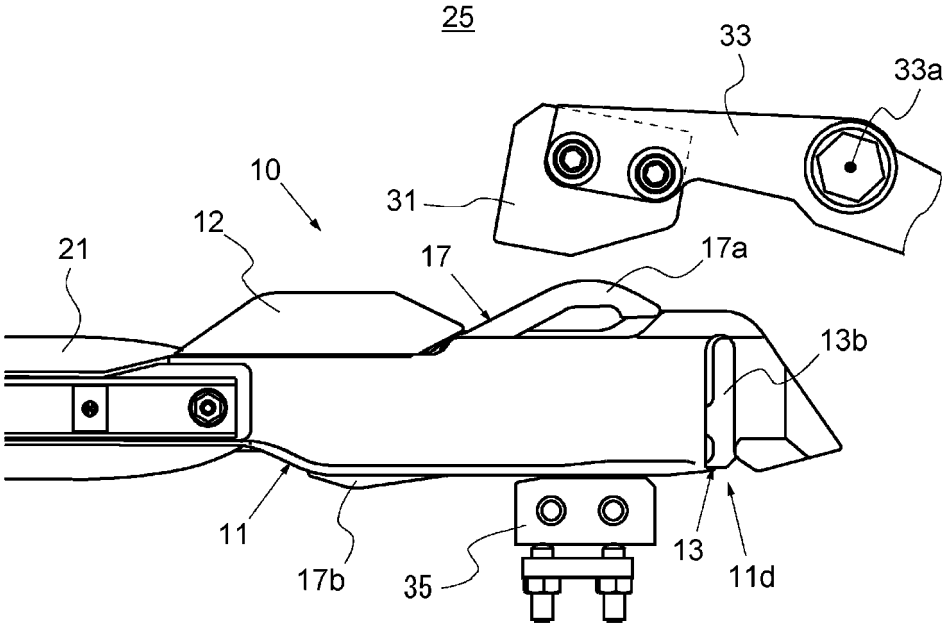

25
33
33a
10
31
12
21
17
17a
13b
11
17b
35
13
11d

FIG. 3B

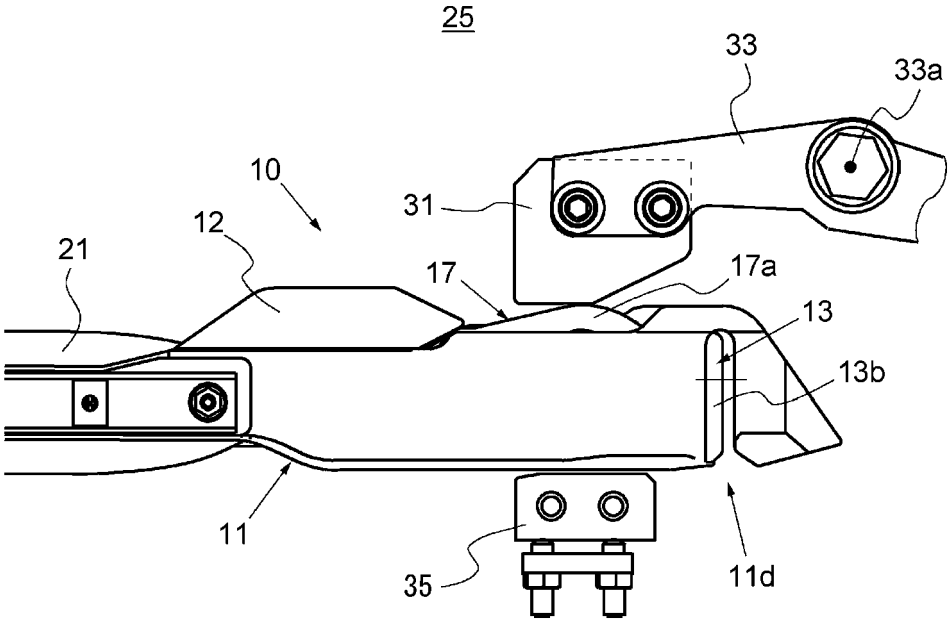

25
33
33a
10
31
12
21
17
17a
13
13b
11
35
11d

FIG. 4A

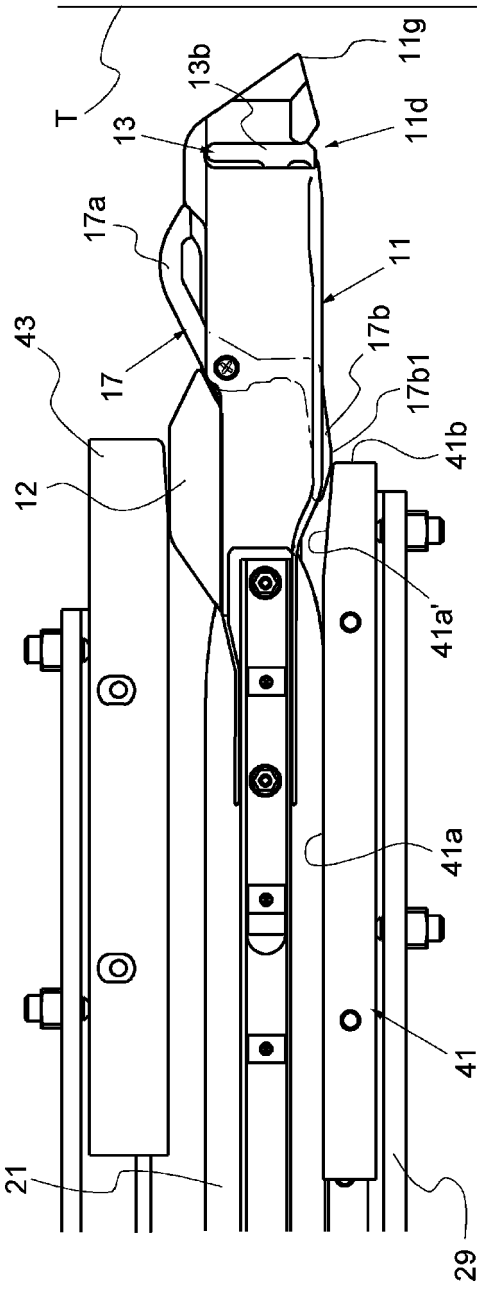

T
13b
11g
13
11d
17a
11
43
17
17b
17b1
41b
12
41a'
41a
41
21
29

FIG. 4B

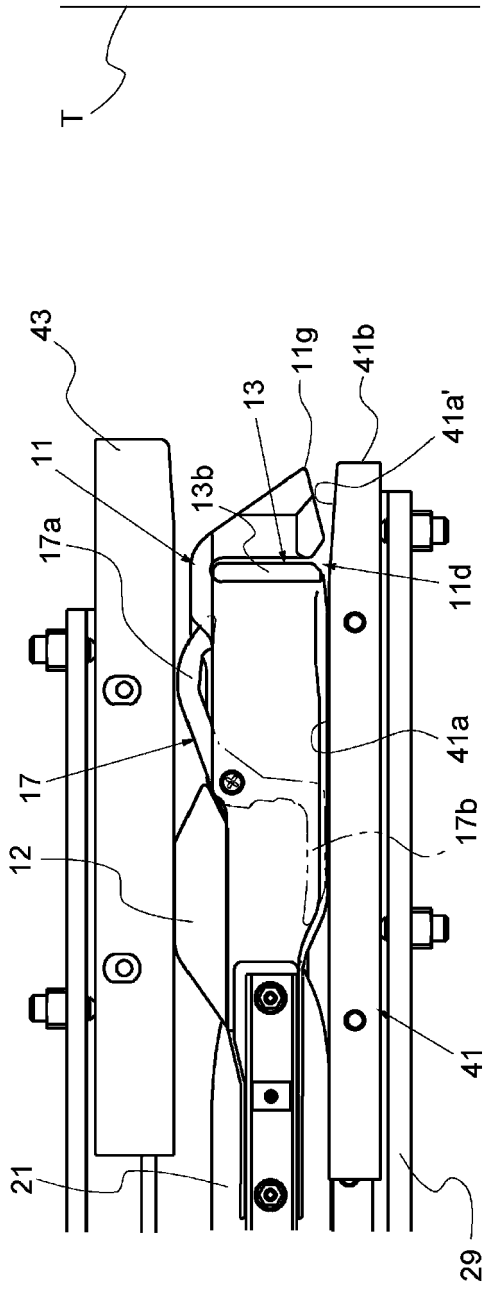

T
43
11
13
11g
41b
41a'
13b
17a
11d
41a
17
17b
12
41
21
29

FIG. 5

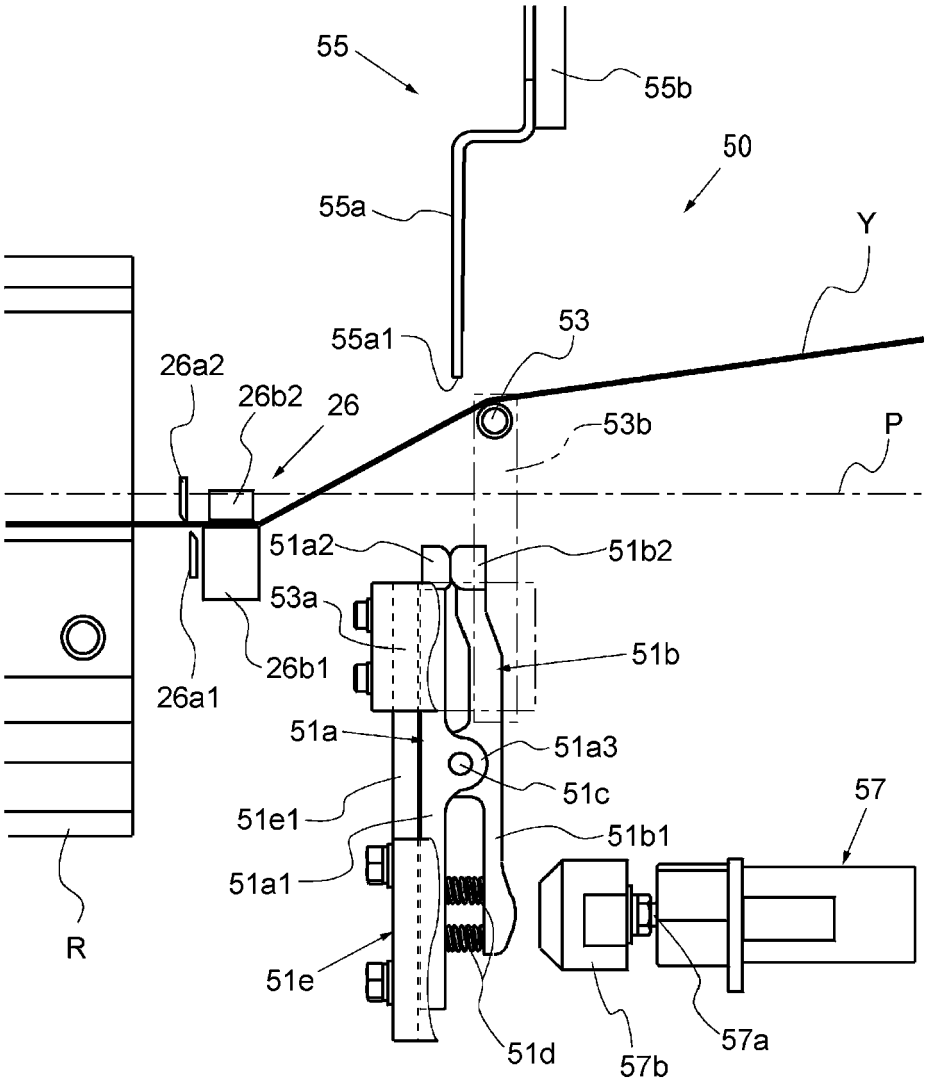

55
55b
50
55a
Y
55a1
53
26a2
26b2
26
53b
P
51a2
51b2
53a
51b
26b1
26a1
51a
51a3
51c
57
51e1
51b1
51a1
R
51e
51d
57b
57a

FIG. 6

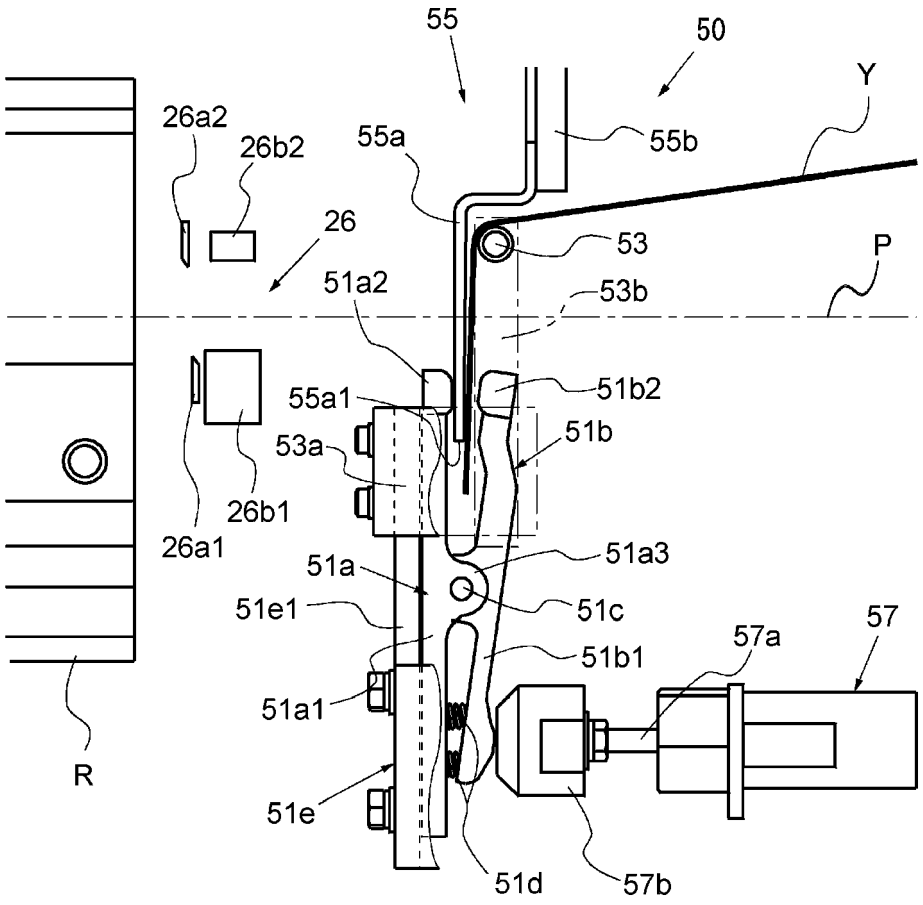

55
50
Y
26a2
26b2
55a
55b
26
53
P
51a2
53b
55a1
51b2
51b
53a
26b1
26a1
51a3
51a
51c
51e1
57
57a
51b1
51a1
R
51e
51d
57b

FIG. 7

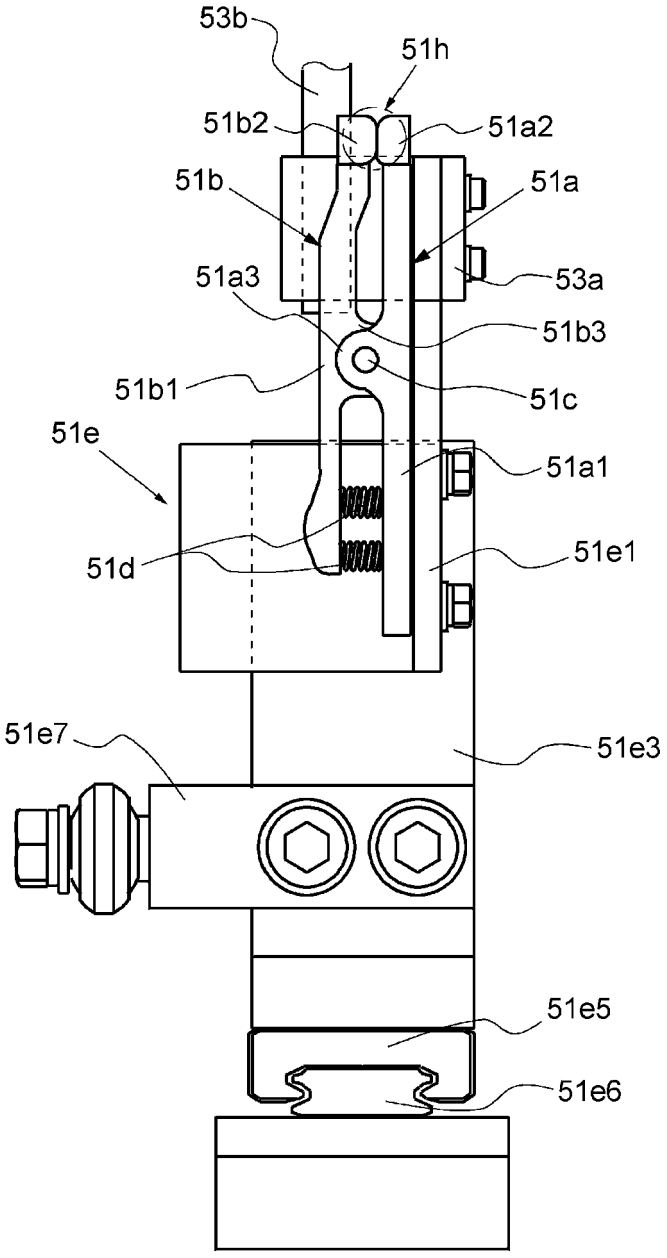

53b
51h
51b2
51a2
51b
51a
51a3
53a
51b3
51b1
51c
51e
51a1
51d
51e1
51e7
51e3
51e5
51e6

FIG. 8B

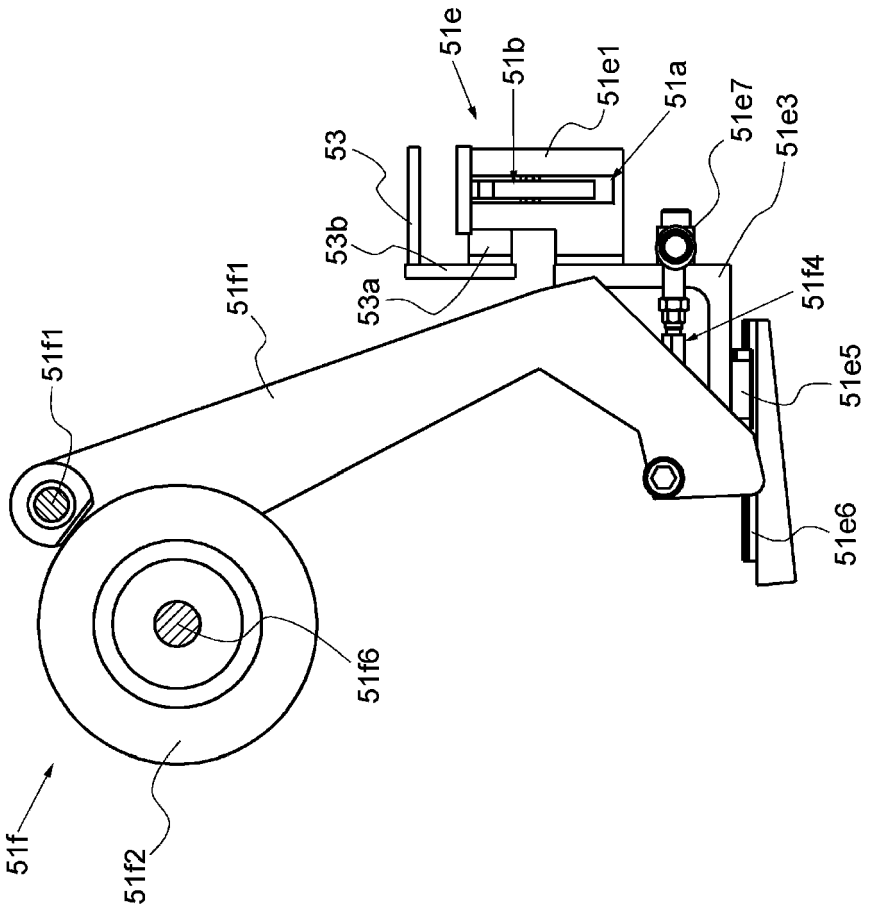

51e
51b
51e1
51a
51e7
51e3
53
53b
53a
51f1
51f4
51e5
51f1
51e6
51f6
51f
51f2

FIG. 8A

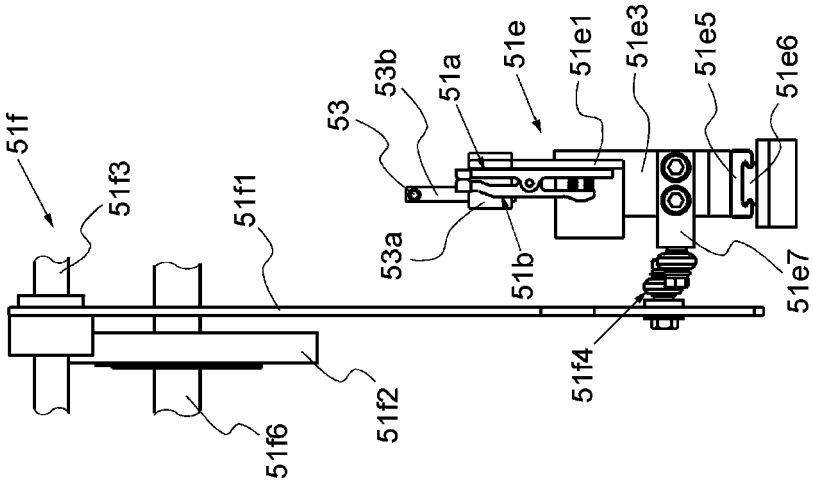

51f
51f3
51f1
53
53b
51a
51e
51e1
51e3
51e5
51e6
53a
51b
51e7
51f4
51f6
51f2

FIG. 9B

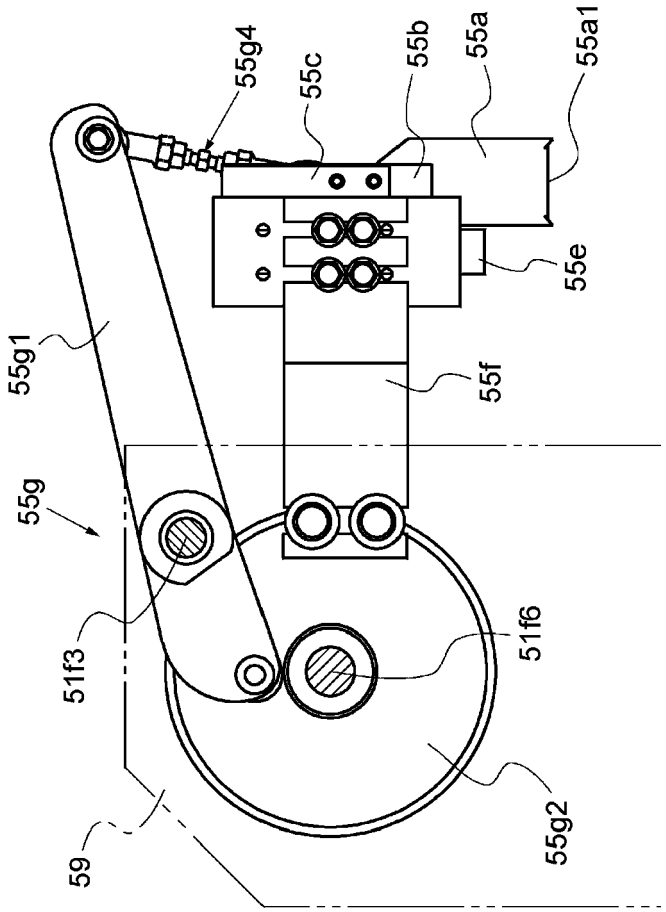

55g4
55c
55b
55a
55a1
55e
55g1
55f
55g
51f3
51f6
55g2
59

FIG. 9A

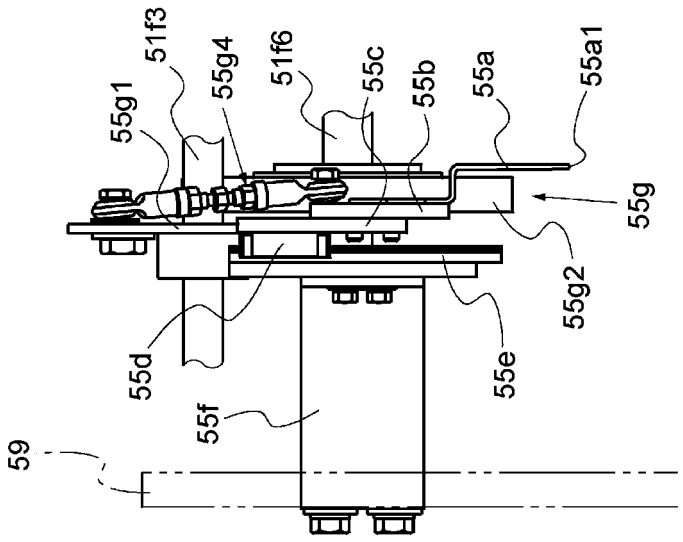
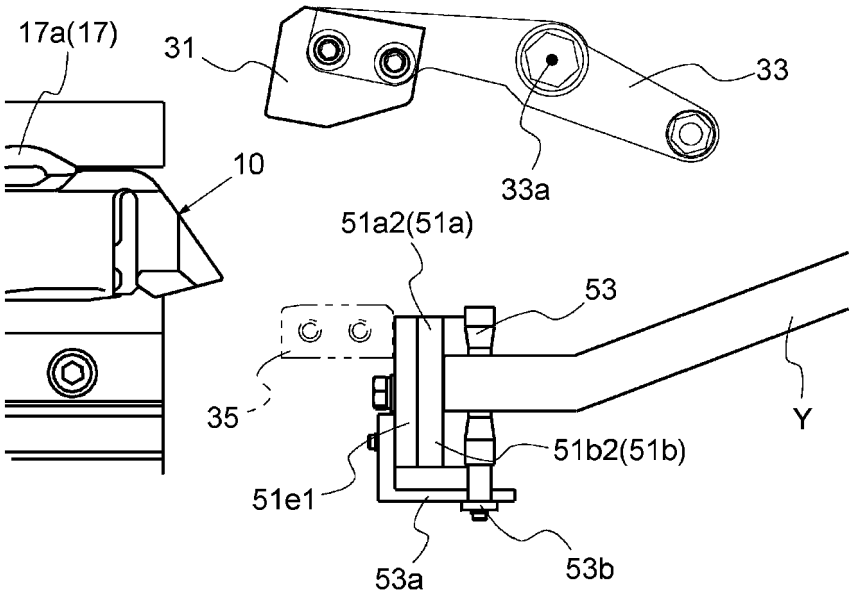

51f3
55g4
51f6
55c
55b
55a
55a1
55g1
55g
55g2
55d
55e
55f
59

FIG. 10


17a(17)
31
33
10
33a
51a2(51a)
53
35
Y
51b2(51b)
51e1
53a
53b

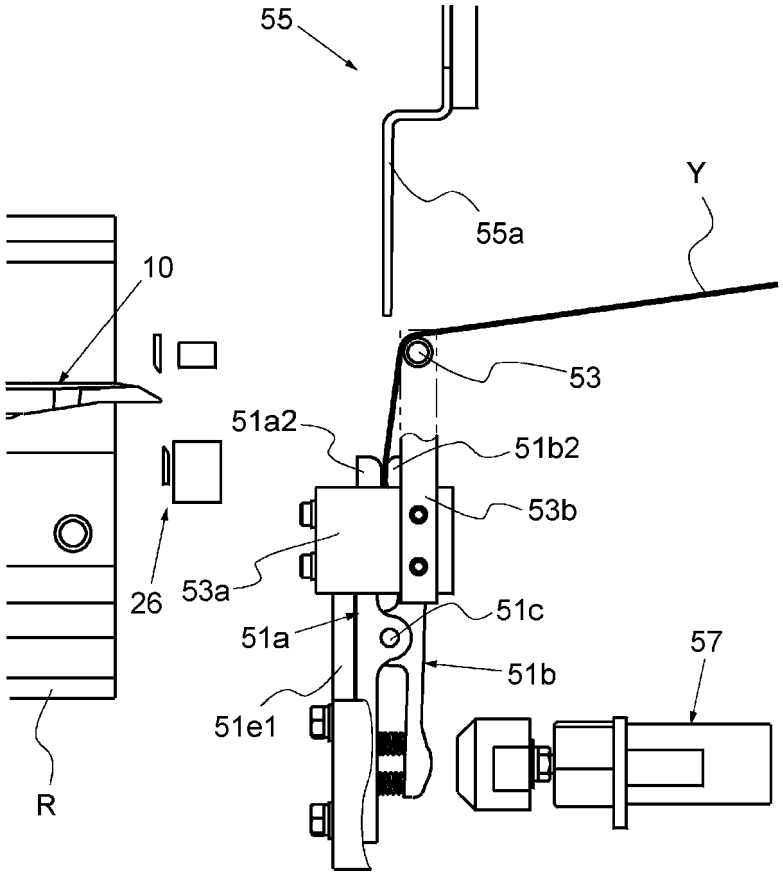
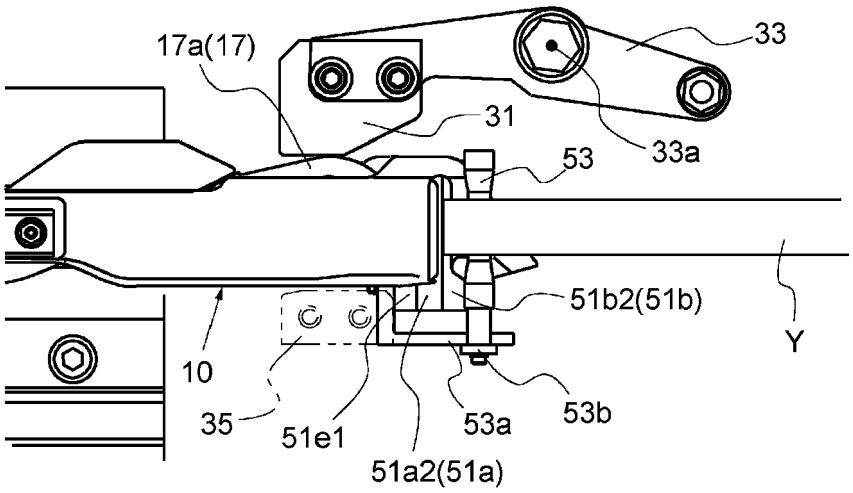

55
55a
Y
10
53
51a2
51b2
53b
53a
26
51c
51a
57
51b
51e1
R

FIG. 11


17a(17)
33
31
33a
53
51b2(51b)
Y
10
35
51e1
53a
53b
51a2(51a)

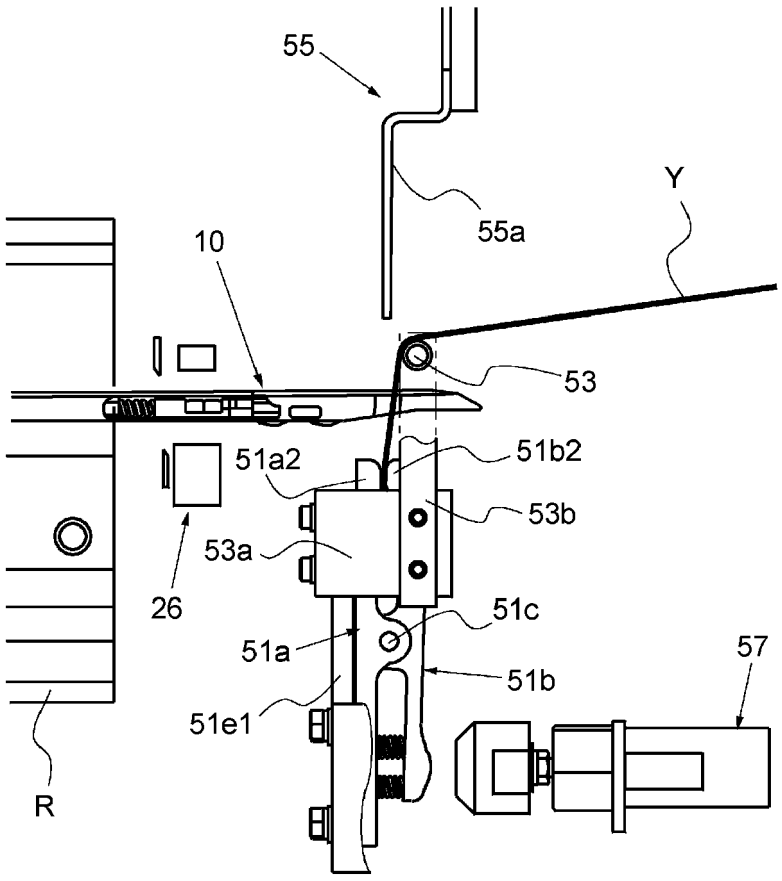

55
55a
Y
10
53
51a2
51b2
53b
53a
26
51c
51a
57
51b
51e1
R

FIG. 12

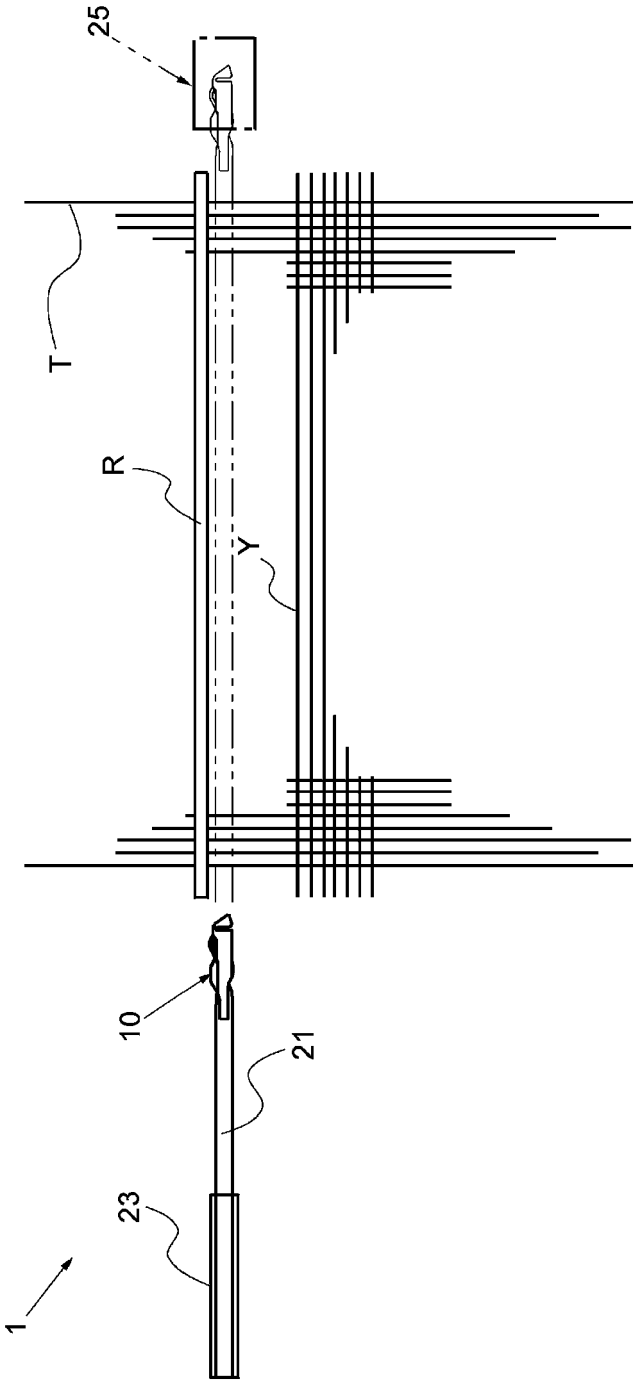


FIG. 13A

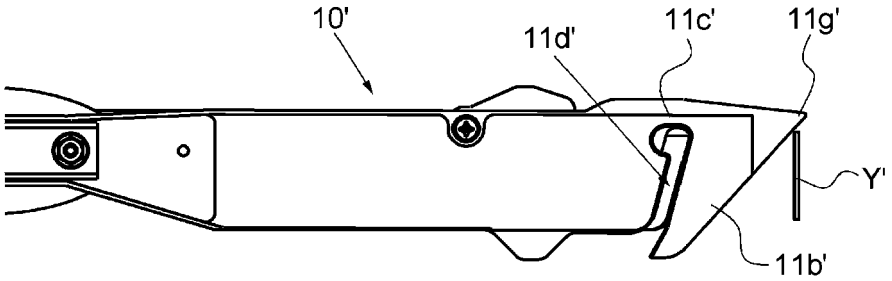


FIG. 13B

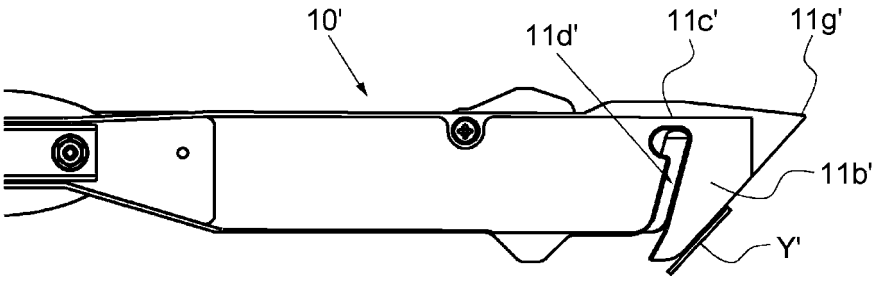


FIG. 13C

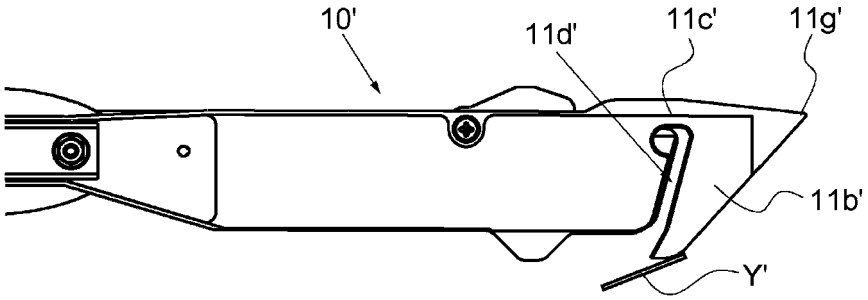
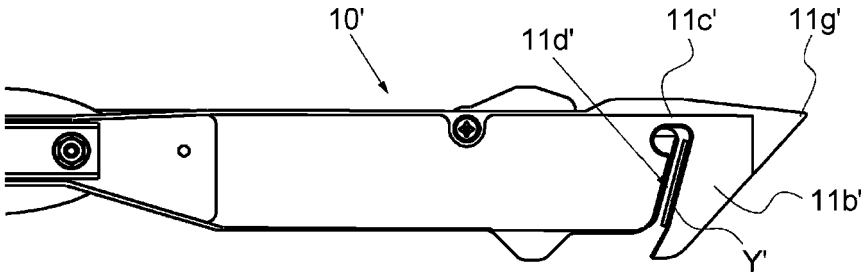


FIG. 13D



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EUROPEAN SEARCH REPORT

Application Number
EP 18 19 0364

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D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 February 2019	Heinzelmann, Eric

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