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

(11) EP 2 184 390 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.05.2010 Bulletin 2010/19

(51) Int Cl.:
D03D 49/12 *(2006.01)*

(21) Application number: **09013172.3**

(22) Date of filing: **19.10.2009**

(84) Designated Contracting States:
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 SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **10.11.2008 JP 2008288054**

(71) Applicant: **TSUDAKOMA KOGYO KABUSHIKI KAISHA**
Kanazawa-shi,
Ishikawa-ken 921-8650 (JP)

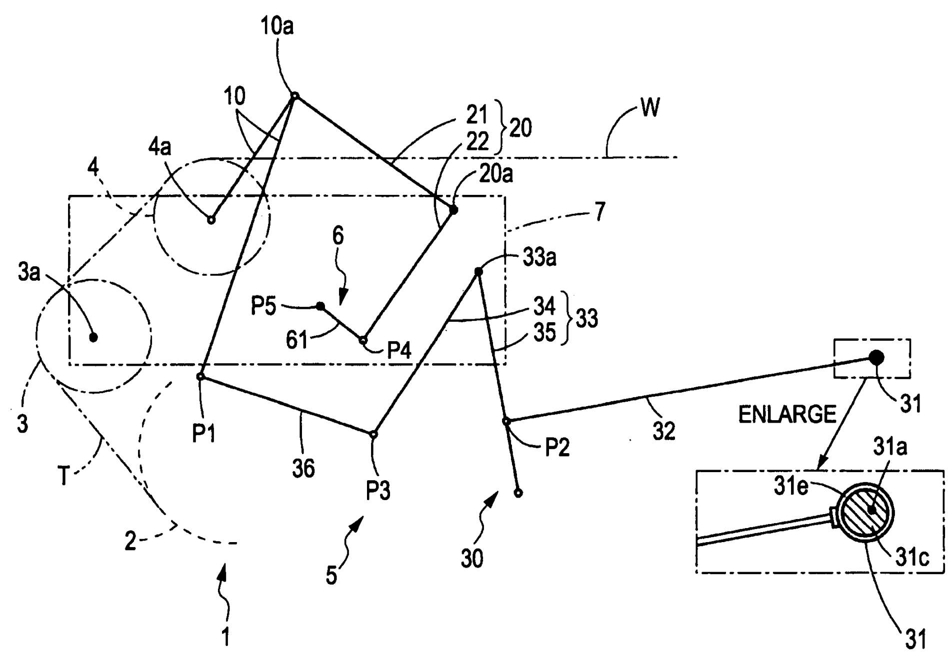
(72) Inventor: **Myogi, Keiichi**
Kanazawa-shi
Ishikawa-ken 921-8650 (JP)

(74) Representative: **Samson & Partner**
Widenmayerstrasse 5
80538 München (DE)

(54) Let-off device of loom using positive easing mechanism

(57) A let-off device (1) of a loom uses a positive easing mechanism (5), which includes a tension lever (10) supporting the easing roller (4) and swingably supported by a first shaft (10a), a second lever (20) supporting the first shaft (10a) and swingably provided at a second shaft (20a) fixedly arranged at a frame (F) of the loom, and a drive mechanism (30) coupled to the tension lever (10) and driving the tension lever (10) to swing. The drive mechanism (30) includes a drive portion (31) fixed to the frame (F), and a connecting rod (32) coupled to the drive portion (31). The connecting rod (32) is coupled to the tension lever (10) via a third lever (33) and a link (36), the third lever (33) swingably provided at a third shaft (33a) fixedly arranged at the frame (F), the link (36) coupled to the third lever (33).

FIG. 1



EP 2 184 390 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a let-off device of a loom using a positive easing mechanism. The positive easing mechanism causes an easing roller to positively perform an easing operation. The easing roller guides warps let off from a let-off beam. A tension detector is attached to the easing roller via a tension lever etc. The easing roller is commonly used for the easing operation and detection of a warp tension.

2. Description of the Related Art

[0002] Fig. 6 illustrates a let-off device of a loom using a positive easing mechanism according to related art. In the following description, a coupling portion close to a drive device is called driving-side end part and a coupling portion far from the drive device is called driven-side end part for members of the let-off device of the loom in view of the coupling order from the drive device. Warps 101 let off from a let-off beam 100 are guided to an easing roller 103 via a back roller 102, and then are guided to a cloth fell. Either end of the easing roller 103 is supported by an intermediate part of a tension lever 104. The driven-side end part (i.e., support point) of the tension lever 104 is swingably supported by a first shaft 105. The driving-side end part of the tension lever 104 is coupled to the driven-side end part of a connecting rod 106 which is capable of being advanced and retracted. An eccentric crank portion 107, serving as a drive portion, is supported by a frame of the loom and coupled to the driving-side end part of the connecting rod 106. The first shaft 105 is supported by the driving-side end part of a second lever 108. An intermediate portion of the second lever 108 is supported by a second shaft 109. The second shaft 109 is supported swingably with respect to the frame. Hence, the positive easing mechanism causes the driven-side end part of the connecting rod 106 to be advanced or retracted because of driving of the eccentric crank portion 107. The advancement and retraction cause the tension lever 104 to swing around the first shaft 105 as the support point. Consequently, the easing roller 103 is displaced.

[0003] The let-off device of the loom also includes a warp tension detection mechanism which detects a warp tension to be transmitted to the easing roller 103. The warp tension detection mechanism uses part of the positive easing mechanism. A tension detector 110 is arranged between and coupled to the driven-side end part of the second lever 108 and the frame of the loom. A force acting on the easing roller 103 because of a tension of the warps 101 acts on the second lever 108, which uses the second shaft 109 as the support point, successively via the tension lever 104 and the first shaft 105. The tension detector 110 detects the acting force and hence detects the warp tension. A similar mechanism to that in Fig. 6 is disclosed in Japanese Unexamined Patent Application Publication No. 2008-19516.

[0004] Meanwhile, there is provided a let-off device of a loom using the above-described positive easing mechanism, in which an easing amount is adjustable. For example, the easing amount is adjusted by changing a coupling position between the tension lever 104 and the connecting rod 106.

[0005] In the let-off device of related art, however, when the easing amount is adjusted by changing the coupling position between the tension lever 104 and the connecting rod 106, a phenomenon may occur in which a detection value detected by the tension detector varies although the warp tension is not changed. In the loom, the warp tension is controlled on the basis of the detection value detected by the tension detector. Hence, when the detection value for the same warp tension varies between situations before and after an adjustment, the warp tension control may be incorrect, and the quality of a woven fabric may be degraded.

[0006] The inventor of the subject application has studied on this, and has found that the detection varies between the situations before and after the adjustment because an angle defined by the tension lever 104 and the connecting rod 106 varies between the situations before and after the adjustment and because a distance from the coupling position between the tension lever 104 and the connecting rod 106 to the first shaft 105 (swing support point) varies between the situations before and after the adjustment.

[0007] More specifically, describing this on the basis of the structure of the let-off device, with reference to Fig. 6, the tension lever 104 is supported at two points including a pin P1 at the coupling position between the tension lever 104 and the connecting rod 106, and the first shaft 105. The first shaft 105, which supports one of the two points of the tension lever 104, is supported by the second shaft 109 via the second lever 108. The pin P1, which is the other of the two points of the tension lever 104 is supported by the eccentric crank portion 107 via the connecting rod 106.

[0008] In the let-off device with the above-described structure, when the coupling position between the tension lever 104 and the connecting rod 106 is changed to adjust the easing amount, the other of the two points for supporting the tension lever 104 is displaced. Hence, the tension lever 104 may incline around the one of the two points as a support point. With the inclination, the angle defined by the tension lever 104 and the connecting rod 106 varies between the situations before and after the adjustment.

[0009] When the angle defined by the tension lever 104 and the connecting rod 106 varies, the detection value of the tension detector 110 also varies because of the following reason. Referring to Fig. 6, the tension lever 104 is supported at the two points of the pin P1 at the coupling position to the connecting rod 106, and the first shaft 105. Also, the connecting rod 106 is supported at the pin P1 at the coupling position to the tension lever 104. The connecting rod 106 is rotatable at the coupling position to the drive portion (eccentric crank portion 107). Accordingly, regarding a force acting on the pin P1 at the coupling position between the tension lever 104 and the connecting rod 106, a component of the force in a longitudinal direction of the connecting rod 106 is supported by the pin P1, and components of the force in other directions are supported by the first shaft 105 via the tension lever 104.

[0010] To be more specific, a resultant force of the warp tension acts on the easing roller 103. The resultant force acts on the tension lever 104 which supports the easing roller 103. Assuming that the resultant force of the warp tension acting on a shaft 103a of the easing roller 103 is a vector F1, the vector F1 is divided into a vector F2 along an extension line from the pin P1 and a vector F3 along an extension line from the first shaft 105. The vectors F2 and F3 respectively act on the pin P1 and the first shaft 105 along the extension lines.

[0011] At the pin P1, the vector F2 acting on the pin P1 is divided into a vector F4, which is a component in the longitudinal direction of the connecting rod 106, and a vector F5, which is a component along an extension line from the first shaft 105. As described above, regarding the force acting on the coupling position between the tension lever 104 and the connecting rod 106, only the component of the force in the longitudinal direction of the connecting rod 106 is supported by the pin P1, and the components of the force in the other directions are supported by the first shaft 105 via the tension lever 104. Hence, at the pin P1, only the vector F4 is supported by the pin P1, and the vector F5 is supported by the first shaft 105 via the tension lever 104.

[0012] For example, when an angle defined by a line connecting the pin P1 and the first shaft 105 is 90°, assuming that an angle defined by a line connecting the pin P1 and the shaft 103a and a line connecting the pin P1 and the first shaft 105 is $\alpha°$, the component of the vector F2 at the pin P1 in the longitudinal direction of the connecting rod 106 is expressed as $F4 = F2 \times \sin\alpha°$, and the component along the extension line from the first shaft 105 is expressed as $F5 = F2 \times \cos\alpha°$. If the angle, which is defined by the connecting rod 106 and the line connecting the pin P1 and the first shaft 105, is deviated from 90° by $\theta°$, the component in the longitudinal direction of the connecting rod 106 becomes $F4' = F4 \times \sec\theta°$, and the component along the extension line from the first shaft 105 becomes $F5' = F5 + F4' \times \tan\theta°$.

[0013] As described above, when the angle defined by the tension lever 104 and the connecting rod 106 varies, the degree of force supported at the coupling position between the tension lever 104 and the connecting rod 106 varies, and the degree of force supported by the first shaft 105 varies. As a result, the detection value of the tension detector 110 varies.

[0014] Changing the coupling position between the tension lever 104 and the connecting rod 106 to adjust the easing amount may change a lever length of the tension lever 104 (i.e., the distance from the coupling position between the first shaft 105 and the connecting rod 106) and may increase a change in a force acting on the first shaft 105, resulting in the detection value of the tension detector 110 further increasing.

[0015] There is a loom in which at least one of a warp line height and a warp line length is adjustable. The term "warp line length" used herein means a distance between the easing roller 103 and a heald frame (not shown). In the loom using the above-described let-off device, the warp line height or the warp line length are adjusted by moving the position of the first shaft 105 supporting the tension lever 104 so as to change the position of the tension lever 104 supporting the easing roller 103. Since the first shaft 105 is supported by the second shaft 109 via the second lever 108, the position of the first shaft 105 (tension lever 104) is changed by changing the position of the second shaft 109 relative to the frame. When the position of the first shaft 105 is changed to adjust the warp line height and the warp line length, one of the two points supporting the tension lever 104 is displaced. Hence the angle defined by the tension lever 104 and the connecting rod 106 may vary between situations before and after the adjustment. In this case, similarly to the case of adjustment of the easing amount, the detection value of the warp tension may vary between the situations before and after the adjustment.

SUMMARY OF THE INVENTION

[0016] In light of the situations, an object of the present invention is to increase a quality of a woven fabric while decreasing a variation in detection value of a tension detector between situations before and after adjustment of an easing amount.

[0017] According to an aspect of the present invention, a let-off device of a loom uses a positive easing mechanism, which causes an easing roller to positively perform an easing operation. The easing roller guides warps let off from a let-off beam. The positive easing mechanism includes a tension lever supporting the easing roller and swingably supported by a first shaft, a second lever supporting the first shaft and swingably provided at a second shaft fixedly arranged at a frame of the loom, and a drive mechanism coupled to the tension lever and driving the tension lever to swing. The drive mechanism includes a drive portion fixed to the frame of the loom, and a connecting rod coupled to the drive portion.

[0018] The connecting rod is coupled to the tension lever via a third lever and a link, the third lever swingably provided at a third shaft fixedly arranged at the frame, the link coupled to the third lever.

[0019] The connecting rod is coupled to the tension lever via a third lever and a link, the third lever swingably provided at a third shaft which is fixedly arranged at the frame of the loom, the link coupled to the third lever.

[0020] Accordingly, the easing amount can be adjusted by changing the coupling position between the connecting rod and the third lever. The angle defined by the tension lever and the link would not vary between the situations before and after the adjustment. The force applied when supported by the link due to the warp tension acting on the easing roller does not vary, and hence, the force applied when supported by the first shaft does not vary. Consequently, the detection value of the tension detector does not vary between the situations before and after the adjustment. The control of the warp tension on the basis of the detection value becomes correct, and the quality of the woven fabric is increased.

[0021] The second shaft and the third shaft may be supported by the frame of the loom, or fixedly arranged via a support member fixed to the frame. To adjust the warp line height and the warp line length, the second shaft is moved. At this time, to prevent the angle defined by the tension lever and the link from varying between situations before and after the adjustment, i.e., to prevent the detection value of the tension detector from varying between the situations before and after the adjustment, the third shaft is moved so as not to change the positional relationship between the second shaft and the third shaft. To easily adjust the warp line height and the warp line length, the following configuration is preferred. That is, the second shaft and the third shaft may be supported by a pair of support members which are formed separately from a pair of the left and right frames of the loom. The support members are supported displaceably relative to the frames of the loom.

[0022] Accordingly, by displacing the support members with respect to the pair of left and right frames of the loom, the warp line height and the warp line length can be easily adjusted without the angle defined by the tension lever and the link varying.

[0023] Each of the support members may be formed of a single member or a plurality of members. To easily, individually, and further correctly adjust the warp line height and the warp line length, the following configuration is preferred. Each of the support members is formed of two members including a first bracket member which extends backward and is supported displaceably in an up-down direction relative to the corresponding frame of the loom and a second bracket member which is supported displaceably in a front-back direction relative to the first bracket member, and the second shaft and the third shaft are supported by the second bracket member.

[0024] Accordingly, by displacing the first bracket member in the up-down direction or by displacing the second bracket member in the front-back direction, the warp line height and the warp line length can be adjusted individually and further correctly.

[0025] The third lever may be coupled to the connecting rod only at one position. Alternatively, the coupling position may be changeable to adjust the easing amount at the coupling position. To easily adjust the easing amount, the following configuration is preferred. The third lever may have at least two coupling positions to the connecting rod to allow an easing amount to be adjustable.

[0026] Accordingly, since the coupling position can be changed with respect to a predetermined position, the easing amount can be further easily adjusted.

[0027] The third lever may be formed of a single member and arranged at an inner or outer side of the support member. However, to decrease a whole length of the easing roller, to decrease the inertia, to decrease the cost, and to easily adjust the easing amount, the following configuration is preferred. That is, the third lever may be formed of two members including a first member which is arranged at an inner side of the corresponding support member and a second member which is arranged at an outer side of the support member. The first member and the second member may be coupled to each other by the third shaft which penetrates through the support member.

[0028] Accordingly, the first member arranged at the inner side of the support member can be coupled to the link, and the second member arranged at the outer side of the support member can be coupled to the connecting rod. The easing roller, the tension lever, and the link can be arranged at the inner side of the corresponding support member, whereas the coupling position between the third lever and the connecting rod can be arranged at the outer side of the support member. Hence, the whole length of the easing roller can be decreased, the inertia can be decreased, and the cost can be decreased. In addition, the easing amount can be easily adjusted at the outer side of the support member.

[0029] The second lever may be formed of a single member and arranged at an inner or outer side of the support member. However, to easily adjust and replace a tension detector, the following configuration is preferred. That is, the second lever may be formed of two members including a third member which is arranged at an inner side of the corresponding support member and a fourth member which is arranged at an outer side of the support member. The third member and the fourth member may be coupled to each other by the second shaft which penetrates through the support member.

[0030] Accordingly, the third member arranged at the inner side of the support member can be coupled to the tension lever, and the fourth member arranged at the outer side of the support member can be coupled to the tension detector. Hence, the tension detector can be arranged at the outer side with respect to the support member, and the tension detector can be easily adjusted or replaced.

[0031] The drive mechanism may be provided only at one side of the frame. In this case, to transmit the easing operation, the third shaft has to be inserted through the pair of left and right frames, as a single shaft. Also, the rigidity of the third shaft has to be increased to prevent tension detection from becoming unstable because the third shaft is twisted. The rigidity of a shaft can be increased by changing the diameter and material of the shaft. However, if the diameter of the third shaft is increased, the inertia of the third shaft is increased. If the material of the shaft is changed, the manufacturing cost is increased. To prevent such problems, the following configuration is preferred. That is, a pair of the drive mechanisms may be provided at both of the pair of left and right frames. Also, the third shaft may be a pair of shafts provided respectively for the support members.

[0032] Since the pair of the drive mechanisms are provided at both of the pair of left and right frames of the loom, the rigidity of the third shaft does not have to be increased as compared with the case in which the drive mechanism is provided only at one of the frames. Accordingly, the third shaft can be decreased in weight, and the inertia can be decreased. Since the third shaft is the pair of shafts provided respectively for the support members, the third shaft can be decreased in weight, and the inertia can be further decreased.

[0033] The first shaft and the third shaft may be arranged at different sides with respect to the link when viewed from axial directions of the shafts. However, when the easing amount is adjusted in this case, the center of amplitude of the link with respect to the tension lever may be changed between situations before and after the adjustment.

[0034] This will be described in detail with reference to Figs. 7 and 8. With reference to a tension lever 10, a link 36 swings relative to the tension lever 10. The center of amplitude of swinging is a position at an intermediate point of amplitude of swinging when the link 36 swings from an angle β_1 of the link 36, at which the tension lever 10 is located at a most retracted position, to an angle β_2 of the link 36, at which the tension lever 10 is located at a most advanced position. Thus, the center of the amplitude is a position, at which the angle to the tension lever 10 is $(\beta_1 + \beta_2)/2$.

[0035] Referring to Fig. 7, when a first shaft 10a and the third shaft 33a are arranged at different sides with respect to the link 36, for example, if the amplitude of swinging is adjusted to increase the easing amount, the angle β_1 of the link 36 with respect to the tension lever 10 at the most retracted position and the angle β_2 of the link 36 with respect to the tension lever 10 at the most advanced position are increased toward an obtuse angle side. Hence, the angle as the center of the amplitude $(\beta_1 + \beta_2)/2$ is also increased toward the obtuse angle side. Typically, the warp tension varies because of shedding of warps and beating up in a single cycle of a loom. Although easing is performed, the variation cannot be completely eliminated. Therefore, for the tension control of the let-off device, detection values of the warp tensions, which are detected a plurality of times during a single cycle (or a predetermined average period) of the loom, may be averaged, and the average value may be used as a warp tension value for the control. However, when the average value of the warp tensions is used, if the center of the amplitude varies, the calculated warp tension value (average value) may vary between situations before and after the adjustment of the easing amount although the actual warp tension is not changed. Consequently, in the case of the tension control of the let-off device in which the average value is used as the warp tension value, the control of the warp tension may become incorrect, and the quality of a woven fabric may be degraded. To prevent this, the following configuration is preferred. That is, referring to Fig. 8, the first shaft 10a and the third shaft 33a may be arranged at the same side with respect to the link 36 when viewed from a direction parallel to axial directions of the first shaft 10a and the third shaft 33a.

[0036] Accordingly, even when the easing amount is adjusted, a change can be prevented from appearing at the center of the amplitude of the link with respect to the tension lever, between the situations before and after the adjustment. Hence, in a single cycle of the loom, even when the average value of the detection values detected a plurality of times is used as the warp tension value for the tension control, the detection values can be treated substantially equivalently between the situations before and after the adjustment of the easing amount. Thus, the quality of the woven fabric can be prevented from being degraded as a result of the adjustment of the easing amount.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037]

Fig. 1 is an explanatory view showing a positive easing mechanism in a let-off device of a loom;

Fig. 2 is a plan view of the let-off device of the loom, Fig. 2 particularly showing a right part when viewed from a let-off side;

Fig. 3 is a plan view of the let-off device of the loom, Fig. 3 particularly showing a left part when viewed from the let-off side;

Fig. 4 is a side view along arrow IV in Fig. 2, showing a tension detector, an eccentric crank portion, etc., from the outer side in a width direction of a woven fabric;

Fig. 5 is a side cross-sectional view taken along line V-V in Fig. 3, showing a third lever, a link, etc., from the inner side in the width direction of the woven fabric;

Fig. 6 is an explanatory view showing a positive easing mechanism of related art;

Fig. 7 is a partial explanatory view showing a situation in which first and third shafts of a positive easing mechanism in Fig. 1 are not arranged at the same side with respect to a link; and

Fig. 8 is a partial explanatory view showing a situation in which first and third shafts of a positive easing mechanism in Fig. 1 are arranged at the same side with respect to a link.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] An embodiment of a let-off device 1 of a loom using a positive easing mechanism 5 will be described below with reference to Figs. 1 to 5. In the following description, "a front-back direction" represents a moving direction of warps when the warps are let off. Also, "a front side" represents a take-up side in a warp direction of the loom, and "a back side" represents a let-off-device-1 side. Fig. 1 is an explanatory view showing the positive easing mechanism 5 in the let-off device 1 of the loom. Black dots in Fig. 1 are support points directly or indirectly fixed to a frame. White dots in Fig. 1 are support points not fixed to the frame. Fig. 2 is a plan view of the let-off device 1 of the loom, Fig. 2 particularly showing a right part when viewed from the back side. Fig. 3 is a plan view of the let-off device 1 of the loom, Fig. 3 particularly showing a left part when viewed from the back side. Fig. 4 is a side view along arrow IV in Fig. 2, showing a tension detector 61, an eccentric crank portion 31 serving as a drive portion, etc., from the outer side in a width direction of a woven fabric. Fig. 5 is a side cross-sectional view taken along line V-V in Fig. 3, showing a third lever 33, a link 36, etc., from the inner side in the width direction of the woven fabric.

[0039] The let-off device 1 of the loom includes a let-off beam 2, around which a plurality of warps T are wound in a sheet form; a back roller 3, which guides the warps T let off from the let-off beam 2; an easing roller 4, which guides the warps T fed from the back roller 3; a positive easing mechanism 5, which causes the easing roller 4 to positively perform an easing operation; a warp tension detection mechanism 6, which uses part of the positive easing mechanism 5; and brackets 7 serving as support members, which support at least part of the positive easing mechanism 5. In this embodiment, the positive easing mechanism 5 is configured such that drive mechanisms 30 are arranged at both sides at outer sides of a pair of left and right frames F of the loom to drive the easing roller 4 at both sides. Further, the drive mechanisms 30 can adjust an easing amount. Hereinafter, the above-listed respective components will be described.

[0040] The let-off beam 2 bridges over the pair of left and right frames F of the loom and is rotatably supported by the frames F. The back roller 3 bridges over the pair of left and right frames F of the loom and is rotatably supported by the frames F via the brackets 7. Further, the easing roller 4 bridges over a pair of left and right tension levers 10 of the positive easing mechanism 5 and is supported by the tension levers 10.

[0041] The positive easing mechanism 5 includes the tension levers 10 serving as first levers which support the easing roller 4 and are swingably supported by first shafts 10a at driven-side end parts; second levers 20 which support the first shaft 10a at driving-side end parts and are supported by a second shaft 20a at positions between the driving-side end parts and the driven-side end parts; and the drive mechanisms 30 which are coupled to driving-side end parts of the tension levers 10 and cause the tension levers 10 to swing. The positive easing mechanism 5, in which the pair of left and right tension levers 10, the pair of left and right second levers 20, and the pair of left and right drive mechanisms 30 are respectively provided at both sides of the easing roller 4, causes forces of the drive mechanisms 30 to act on the driving-side end parts of the tension levers 10. The left and right configurations of the positive easing mechanism 5 are basically similar to each other except for parts relating to the warp tension detection mechanism 6. Hence, one of the configurations at both sides of the easing roller 4 of the positive easing mechanism 5 (i.e., the configuration with the warp tension detection mechanism 6) will be described hereinafter.

[0042] The tension lever 10 serves as a first lever, which supports the easing roller 4. The tension lever 10 is a lever formed of a single member similarly to the tension lever of related art shown in Fig. 6. The tension lever 10 has the first shaft 10a at the driven-side end part, and the driving-side end part is coupled to a link 36 of the drive mechanism 30 by a pin P1.

[0043] The tension lever 10 is swingably supported by the first shaft 10a at the driving-side end part of the second lever 20 and at the inner side of the frame F of the loom. More specifically, a through hole 11 is formed at the driven-side end part of the tension lever 10. A sliding bearing 12 is fitted into the inner side of the through hole 11. At the second lever 20, a coupling portion 23 is formed in a C-shaped form and pinches the driven-side end part of the tension lever 10 from the inner and outer sides. The coupling portion 23, positioned at both sides of the sliding bearing 12 of the tension lever 10, has a pair of through holes 23a. The first shaft 10a is fitted to the pair of through holes 23a and the sliding bearing 12. Both end parts of the first shaft 10a and the coupling portion 23 are coupled to each other by setscrews 13. Accordingly, the tension lever 10 is swingably supported by the first shaft 10a which is relatively non-rotatably supported by the second lever 20.

[0044] The easing roller 4 is rotatably supported by the tension levers 10 at a position between the left and right frames F of the loom. More specifically, a thorough hole (not shown) is formed at a position between the driving-side end part and the driven-side end part of the tension lever 10. A sliding bearing 14 is fitted into the through hole. A shaft 4a of the easing roller 4 is fitted to the sliding bearing 14.

[0045] The first shaft 10a is a shaft for supporting the tension lever 10. In Figs. 2 and 3, the first shaft 10a is provided for each tension lever 10. Hence, a pair of left and right first shafts 10a are provided. Alternatively, the first shaft 10a may be a single shaft extending between the left and right tension levers 10 to support the left and right tension levers 10.

[0046] The drive mechanism 30 includes an eccentric crank portion 31, which is fixed to the outer side of the frame F of the loom; a connecting rod 32, whose base part is coupled to an outer ring 31e of the eccentric crank portion 31; a third lever 33, whose driving-side end part is coupled to the driven-side end part of the connecting rod 32 and which swings around a third shaft 33a as a support point; and the link 36, whose both ends are respectively coupled to the driven-side end part of the third lever 33 and the driving-side end part of the tension lever 10 at the inner side of the frame F of the loom.

[0047] The eccentric crank portion 31 includes a crank shaft 31a which is rotatably supported by the frame F, an eccentric ring 31c (inner ring) to which the crank shaft 31a is non-rotatably attached via a hub 31b, and the outer ring 31e which is fitted to a rolling bearing 31d arranged at the outer side of the eccentric ring 31c. The base part of the connecting rod 32 is coupled to the outer ring 31e. Hence, when the crank shaft 31a rotates, the eccentric ring 31c rotates around the crank shaft 31a, and the driven-side end part of the connecting rod 32 arranged via the outer ring 31e reciprocates forward and backward. The crank shaft 31a is coupled to a main shaft (not shown) of the loom via a drive transmission mechanism or the like, and rotates synchronously with the main shaft.

[0048] The driven-side end part of the connecting rod 32 and the driving-side end part of the third lever 33 are coupled to each other via a spherical bearing 32a such that an easing amount is adjustable by a bolt serving as a pin P2. To be more specific, the spherical bearing 32a is provided at the driven-side end part of the connecting rod 32. Two internal thread holes 35c are formed at the driving-side end part of the third lever 33 at an interval in the longitudinal direction. A shaft portion of the bolt serving as the pin P2 is screwed into any of the internal thread holes 35c via the spherical bearing 32a. Hence, the coupling position between the connecting rod 32 and the third lever 33 can be changed. By changing the coupling position, a swing amount of the third lever 33 as a result of the reciprocation of the connecting rod 32 varies. Thus, the easing amount is adjusted. In the illustrated configuration, since the coupling position between the connecting rod 32 and the third lever 33 is any of at least two specific positions, left and right adjustment amounts can be easily aligned with each other as compared with non-step adjustment by way of a long hole or the like. The easing amount can be easily adjusted. While the number of coupling positions is two in the illustrated configuration, the number of coupling positions may be three or more.

[0049] In this embodiment, the third lever 33 is formed of two members including a first member 34 arranged at the inner side of the bracket 7, and a second member 35 arranged at the outer side of the bracket 7. The first member 34 and the second member 35 are coupled to each other by a third shaft 33a which penetrates through the bracket 7 from the inner side to the outer side.

[0050] The first member 34 is coupled to the tension lever 10 arranged at the inner side of the frame F, via the link 36. The first member 34 has through holes 34a and 34b at both end parts (driving-side end part, driven-side end part). A spherical bearing 36b is provided at the driving-side end part of the link 36 to correspond to the through hole 34a at the driven-side end part. A shaft portion of a bolt serving as a pin P3 is inserted through the through hole 34a via the spherical bearing 36b, and a nut (not shown) is screwed to a tip end of the shaft portion.

[0051] The second member 35 is coupled to the driven-side end part of the connecting rod 32 arranged at the outer side of the frame F. The second member 35 has a through hole 35a at the driven-side end part to correspond to the through hole 34b at the driving-side end part of the first member 34. The bracket 7 has a through hole (not shown) arranged between the through holes 34b and 35a. A sliding bearing 35b is fitted into the through hole. The third shaft 33a penetrates through the sliding bearing 35b, and the first member 34 and the second member 35 are non-rotatably coupled to the third shaft 33a by fixing with spilt cramps through the through holes 34b and 35a. As described above, the second member 35 has the plurality of internal thread holes 35c at the driving-side end part for the pin P2.

[0052] The third lever 33 coupled via the connecting rod 32 swings because of the rotation of the eccentric crank portion 31. Hence, the third shaft 33a supporting the third lever 33 is also rotated. In the illustrated configuration, the pair of third shafts 33a are provided respectively for the left and right third levers 33. Thus, each third shaft 33a can be decreased in length and weight. The inertia of the third shaft 33a can be decreased. When the loom is operated at a high speed, a more properly following easing operation can be provided.

[0053] Through not shown, the third shaft 33a may be a single shaft extending between the left and right frames F to support the left and right third levers 33. With this structure, a synchronous easing operation can be easily provided at the left and right sides of the easing roller 4, regardless of both-side driving or one-side driving. When both-side driving is employed, or when the eccentric crank portions 31 and the connecting rods 32 are provided at the left and right sides, the third shaft can be independently provided and hence the above-described advantages can be attained.

[0054] As described above, the spherical bearing 36b is fixed to the driving-side end part of the link 36. The spherical bearing 36b is coupled to the first member 34 of the third lever 33 by the pin P3 and the nut. Similarly, a spherical bearing 36a is fixed to the driven-side end part of the link 36. The spherical bearing 36a is coupled to the driving-side end part of the tension lever 10 by the pin P1 (bolt) and the nut.

[0055] In the illustrated configuration, regarding the arrangement of the first shaft 10a and the third shaft 33a with respect to the link 36, the first shaft 10a and the third shaft 33a are arranged at the same side with respect to the link 36 when view from a direction parallel to axial directions of the first shaft 10a and the third shaft 33a. In particular, Fig. 1 is a view from the direction parallel to the axial directions of the first shaft 10a and the third shaft 33a. In Fig. 1, the link 36 is illustrated as a line whose right end is lower than the left end. The first shaft 10a and the third shaft 33a are arranged at the upper side of an extension line of that line. Through not shown, the first shaft 10a and the third shaft 33a may be arranged at different sides with respect to the link 36.

[0056] The second lever 20 supports the first shaft 10a and converts a force applied to the first shaft 10a into a force applied to the tension detector 61 of the warp tension detection mechanism 6 in the longitudinal direction. The second lever 20 can swing around the second shaft 20a supported by the bracket 7, as a support point. However, since the driven-side end part is fixed to the bracket 7 via the tension detector 61, the second lever 20 is substantially non-displaceable. Herein, the one second lever 20 at the side with the warp tension detection mechanism 6 has been described. The other second lever 20 at the side without the tension detection mechanism 6 supports the first shaft 10a while the driven-side end part of the second lever 20 is not fixed to the bracket 7. The second lever 20 is relatively non-rotatably coupled to the second lever 20 at the side with the warp tension detection mechanism 6 through the second shaft 20a. Hence, the second lever 20 is substantially non-displaceable.

[0057] The second lever 20 is formed of two members including a third member 21 arranged at the inner side of the bracket 7, and a fourth member 22 arranged at the outer side of the bracket 7. The third member 21 and the fourth member 22 are coupled to each other by a second shaft 20a which penetrates through the bracket 7. Herein, the one second lever 20 at the side with the warp tension detection mechanism 6 has been described. The other second lever 20 at the side without the warp tension detection mechanism 6 is formed of only the third member 21, and does not include the fourth member 22.

[0058] The third member 21 has through holes 23a and 23b at both ends (driving-side end part, driven-side end part). As described above, the first shaft 10a is relatively non-rotatably supported by the through hole 23a at the driving-side end part.

[0059] The fourth member 22 has a through hole 22a which corresponds to the through hole 23b at the driven-side end part of the third member 21. The bracket 7 has a through hole (not shown) arranged between the through holes 22a and 23b. A sliding bearing 24 is fitted into the through hole. The second shaft 20a penetrates through the through holes 23b and 22a of the third member 21 and the fourth member 22 and through the sliding bearing 24. The third member 21 and the fourth member 22 are relatively non-rotatably coupled to the second shaft 20a by fixing with a split cramp. Thus, the second shaft 20a does not substantially rotate, resulting in no inertia being generated because of rotation. Hence, the second shaft 20a may be increased in diameter if necessary.

[0060] Also, the fourth member 22 has a through hole (not shown) at the driven-side end part. The tension detector 61 has a spherical bearing 62 at the driving-side end part to correspond to the through hole. The pin P4, the bolt, and the nut are screwed to the through hole and the spherical bearing 62, and thus the fourth member 22 is coupled to the tension detector 61.

[0061] The second shaft 20a is provided as a single shaft to support the left and right second levers 20. Since the tension detector 61 is provided at one side, the tension detector 61 can detect the sum of warp tensions applied to the easing roller 4. Alternatively, a pair of second shafts 20a may be provided respectively for the left and right second levers 20. In this case, if tension detectors 61 are provided respectively for the second levers 20, the sum of detection values obtained from the tension detectors 61 may be equivalent to the detection value which is obtained by the illustrated configuration in which the tension detector 61 is provided only for the second lever 20 at one side.

[0062] The action of the positive easing mechanism 5 will be described below. The third lever 33 coupled via the connecting rod 32 to the eccentric crank portion 31 swings because of the rotation of the eccentric crank portion 31. When the third lever 33 swings, the tension lever 10 coupled via the link 36 to the third lever 33 swings with the easing roller 4. That is, the easing roller 4 performs the easing motion.

[0063] In the warp tension detection mechanism 6, the tension detector 61 detects the warp tension applied to the easing roller 4, through the tension lever 10 and the second lever 20. The tension detector 61 is a load cell including the spherical bearings 62 and 63 are provided at both ends. As described above, the spherical bearing 62 at the one end is coupled to the fourth member 22 of the second lever 20. A second bracket member 72 (described later) of the bracket 7 has an internal thread hole (not shown) to correspond to the spherical bearing 63 at the other end of the tension detector 61. A bolt serving as a pin P5 is inserted through the spherical bearing 63 at the other end and screwed to the internal thread hole. Accordingly, the other end of the tension detector 61 is fixed to the bracket 7.

[0064] The rotation of the let-off beam 2 is controlled on the basis of the detection value of the tension detector 61. If the detection value is higher than a predetermined value, the rotation speed of the let-off beam 2 is increased to increase the let-off speed of the warps T. In contrast, if the detection value is lower than the predetermined value, the rotation speed of the let-off beam 2 is decreased to decrease the let-off speed of the warps T.

[0065] The brackets 7 are provided separately from the frames F of the loom. The brackets 7 are displaceably attached respectively to the pair of left and right frames F. Each bracket 7 supports the second shaft 20a, the third shaft 33a, and the tension detector 61 (if it is provided at the same side). Hence, by displacing the bracket 7 relative to the frame F, the second shaft 20a, the third shaft 33a, and the tension detector 61 (if provided) are displaced relative to the frame F. Accordingly, the easing roller 4 is displaced. The easing roller 4 is displaced to adjust the height of the warp line W (warp line height) and the warp line length.

[0066] To be more specific, the bracket 7 is formed of two members including a first bracket member 71 attached to the frame F in a manner displaceable in the up-down direction, and a second bracket member 72 attached to the first bracket member 71 in a manner displaceable in the front-back direction.

[0067] The first bracket member 71 includes an attachment portion 73 attached to a back side of the frame F, an extending portion 74 extending backward from the attachment portion 73, and a guide portion 75 protruding from the upper end part of the extending portion 74 to the outer side in the lateral direction.

[0068] The attachment portion 73 has a vertical surface to correspond to the back side (illustrated as a vertical surface) of the frame F. The attachment portion 73 has a plurality of long holes 73a extending in the up-down direction. By screwing a bolt B1 to an internal thread hole (reference character omitted) through each long hole 73a and fastening the bolt B1 thereto, the attachment portion 73 (first bracket member 71) is fixed to the frame F. By loosening the bolt B1, the first bracket member 71 together with the second bracket member 72 become displaceable in the height direction. The up-down position (height of warp line W) of the easing roller 4 supported by the second bracket member 72 is adjusted.

[0069] The extending portion 74 is a vertical flat plate. A vertical inner surface of the extending portion 74 serves as a smooth guide surface. A corresponding guide surface of the second bracket member 72 is in contact with the guide surface of the extending portion 74. The extending portion 74 has a plurality of long holes 74a extending in the front-back direction. By screwing a bolt B2 to an internal thread hole (not shown) of the frame F through each long hole 74a and fastening the bolt B2 thereto. Accordingly, the second bracket member 72 is fixed to a side surface of the first bracket member 71.

[0070] The guide portion 75 is a horizontal flat plate. An upper surface of the guide portion 75 serves as a smooth guide surface. A corresponding guide surface of the second bracket member 72 is mounted on the guide surface of the guide portion 75 in a contact manner. The guide portion 75 has a long hole 75a extending in the front-back direction. By screwing a bolt B3 through a long hole 75a to an internal thread hole (not shown) of the second bracket member 72 and fastening the bolt B3 thereto, the second bracket member 72 is fixed onto the upper surface of the first bracket member 71.

[0071] By loosening the bolt B3 for the guide portion 75 and the bolt B2 for the extending portion 74, the second bracket member 72 becomes displaceable relative to the first bracket member 71. Accordingly, the front-back position (interval) of the easing roller 4 is adjusted. The guide portion 75 has a scale M1 at an outer side surface thereof, the scale M1 extending in the front-back direction. The second bracket member 72 has a pointer M2 fixed thereto, to indicate the position in the scale M1.

[0072] The second bracket member 72 has a shape which is aligned with the inner side surface of the extending portion 74 and the upper surface of the guide portion 75 of the first bracket member 71. As described above, the second bracket member 72 is attached to the first bracket member 71 in a manner displaceable in the front-back direction. In addition, a support member (jack bolt 76) is supported at the second bracket member 72 movably in the up-down direction, to prevent the second bracket member 72 from falling and to adjust the height of the second bracket member 72. The second bracket member 72 has an internal thread hole (not shown) penetrating therethrough in the up-down direction. The lower end surface of the jack bolt 76 is capable of contacting the upper surface of the frame F. Hence, the height of the second bracket member 72 is adjusted in accordance with a fastening amount of the jack bolt 76.

[0073] As described above, the second bracket member 72 supports the second shaft 20a and the third shaft 33a, and fixes the other end of the tension detector 61. In addition, the second bracket member 72 supports a shaft 3a of the back roller 3 rotatably via a ball bearing 77.

[0074] The present invention is not limited to the above-described embodiment. For example, in the illustrated configuration, the second lever and the third lever are the two members arranged at the inner and outer sides of the bracket 7. Alternatively, a second lever 20 and/or a third lever 33 may be a single member and arranged at only one of the inner and outer sides of the bracket 7 (or frame F).

[0075] Also, in the illustrated configuration, the support member is a member provided separately from the frame F, and is formed of the two members including the first bracket member 71 attached to the frame F displaceably in the up-down direction, and the second bracket member 72 attached to the first bracket member 71 displaceably in the front-back direction. Alternatively, a bracket may be formed of a single member which is provided separately from the frame F. In this case, a surface of an integrated attachment portion 73 and the back surface of the frame F may be inclined surfaces. The bracket may be displaceable relative to the frame F obliquely along the inclined surface. Accordingly, the warp line height and the warp line length can be simultaneously adjusted.

[0076] Further, the support member does not have to be the bracket 7 which is provided separately from the frame F. If it is not necessary to adjust the warp line height and the warp line length, i.e., if it is only necessary to adjust the easing amount, the support member may be part of the frame F (a member integral with the frame F).

[0077] Also, the drive portion does not have to be the eccentric crank portion 31. The drive portion may be a cam mechanism, or may use an electric motor.

Claims

1. A let-off device (1) of a loom, the let-off device (1) using a positive easing mechanism (5) which causes

an easing roller (4) to positively perform an easing operation, the easing roller (4) guiding warps (T) let off from a let-off beam (2),
wherein the positive easing mechanism (5) includes a tension lever (10), serving as a first lever (10), which supports the easing roller (4) and is swingably supported by a first shaft (10a),
a second lever (20) which supports the first shaft (10a) and is swingably provided at a second shaft (20a), the second shaft (20a) fixedly arranged at a frame (F) of the loom, and
a drive mechanism (30) which is coupled to the tension lever (10) and drives the tension lever (10) to swing, and which includes a drive portion (31) fixedly arranged at the frame (F) of the loom, and a connecting rod (32) coupled to the drive portion (31), and wherein the connecting rod (32) is coupled to the tension lever (10) via a third lever (33) and a link (36), the third lever (33) swingably provided at a third shaft (33a) which is fixedly arranged at the frame (F) of the loom, the link (36) coupled to the third lever (33).

2. The let-off device (1) using the positive easing mechanism (5) according to claim 1, wherein the second shaft (20a) and the third shaft (33a) are supported by a pair of support members (7) which are formed separately from a pair of the left and right frames (F) of the loom, and the support members (7) are supported displaceably relative to the frames (F) of the loom.

3. The let-off device (1) using the positive easing mechanism (5) according to claim 2, wherein each of the support members (7) is formed of two members including a first bracket member (71) which extends backward and is supported displaceably in an up-down direction relative to the corresponding frame (F) of the loom and a second bracket member (72) which is supported displaceably in a front-back direction relative to the first bracket member (71), and the second shaft (20a) and the third shaft (33a) are supported by the second bracket member (72).

4. The let-off device (1) using the positive easing mechanism (5) according to any of claims 1 to 3, wherein the third lever (33) has at least two coupling positions to the connecting rod (32) to allow an easing amount to be adjustable.

5. The let-off device (1) using the positive easing mechanism (5) according to any of claims 1 to 4, wherein the third lever (33) is formed of two members including a first member (34) which is arranged at an inner side of the corresponding support member (7) and a second member (35) which is arranged at an outer side of the support member (7), and the first member (34) and the second member (35) are coupled to each other by the third shaft (33a) which penetrates through the support member (7).

6. The let-off device (1) using the positive easing mechanism (5) according to any of claims 1 to 5, wherein the second lever (20) is formed of two members including a third member (21) which is arranged at an inner side of the corresponding support member (7) and a fourth member (22) which is arranged at an outer side of the support member (7), and the third member (21) and the fourth member (22) are coupled to each other by the second shaft (20a) which penetrates through the support member (7).

7. The let-off device (1) using the positive easing mechanism (5) according to any of claims 1 to 6, wherein a pair of the drive mechanisms (30) are provided at both of the pair of left and right frames (F).

8. The let-off device (1) using the positive easing mechanism (5) according to claim 7, wherein the third shaft (33a) is a pair of shafts provided respectively for the support members (7).

9. The let-off device (1) using the positive easing mechanism (5) according to any of claims 1 to 8, wherein the first shaft (10a) and the third shaft (33a) are arranged at the same side with respect to the link (36) when viewed from a direction parallel to axial directions of the first shaft (10a) and the third shaft (33a).

FIG. 1

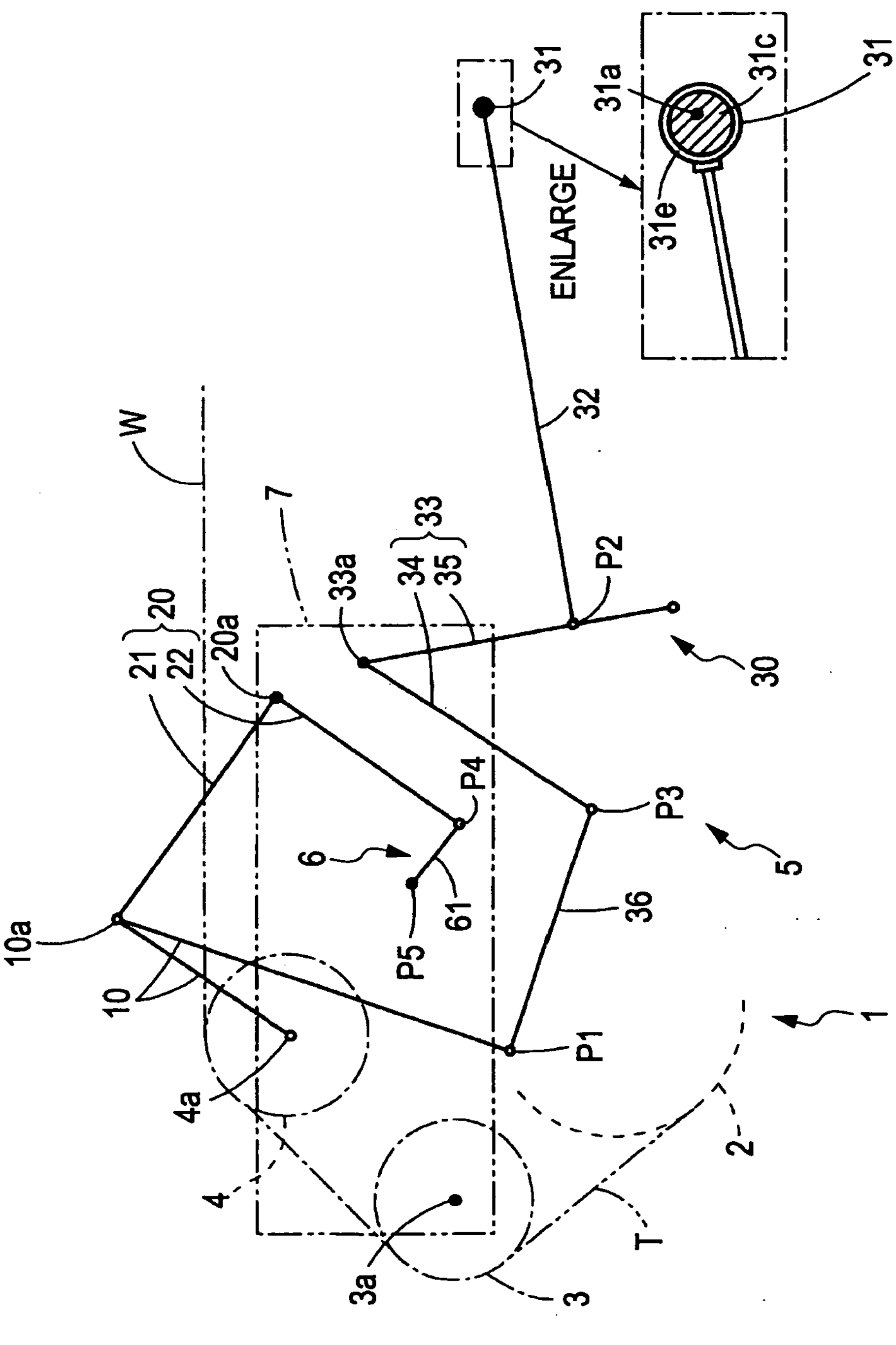

W
7
21
22
20
20a
33a
34
35
33
P2
32
31
ENLARGE
31a
31c
31e
31
30
P3
5
36
P4
6
61
P5
10a
10
P1
1
4a
4
2
3a
3
T

FIG. 2

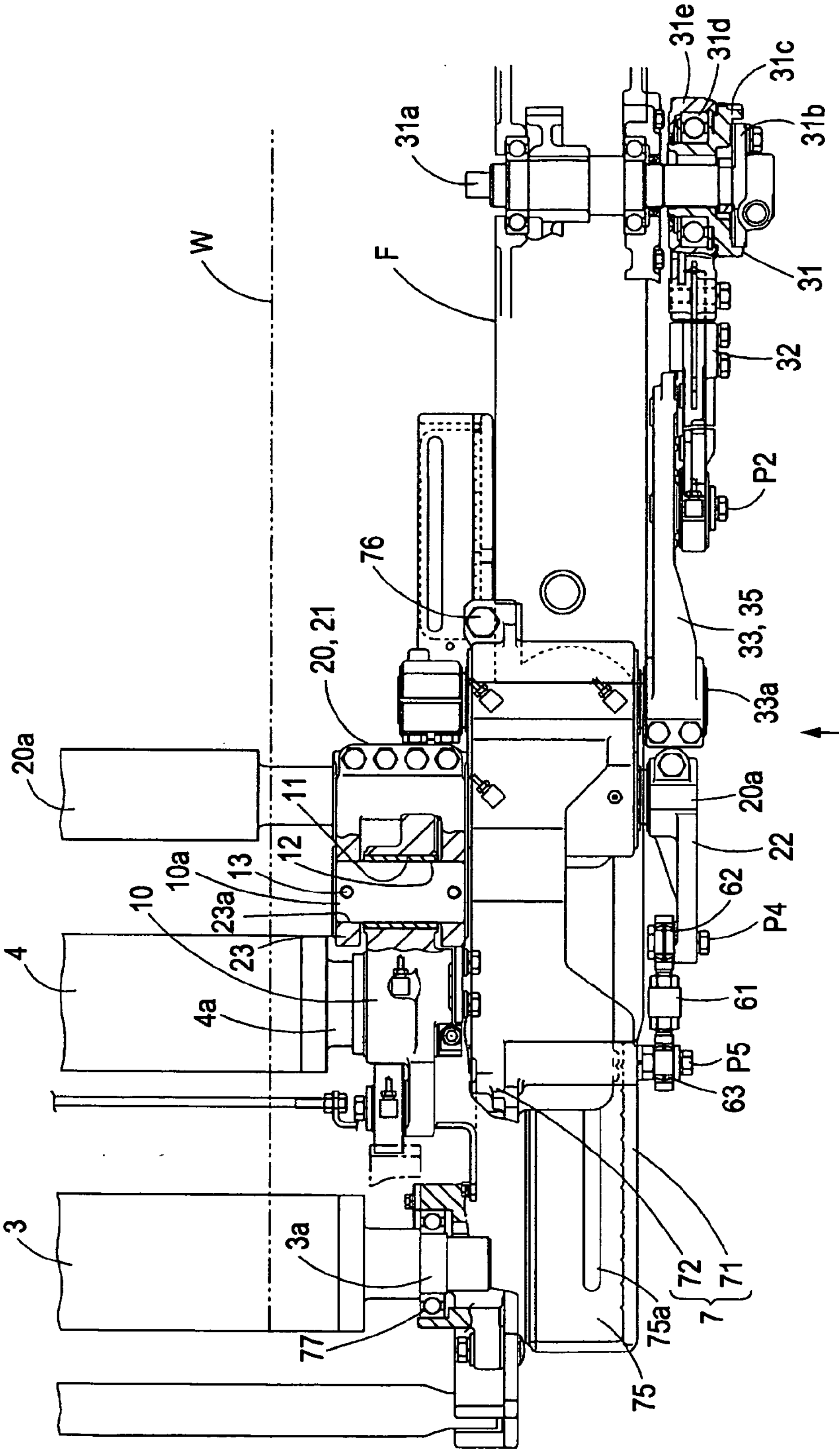
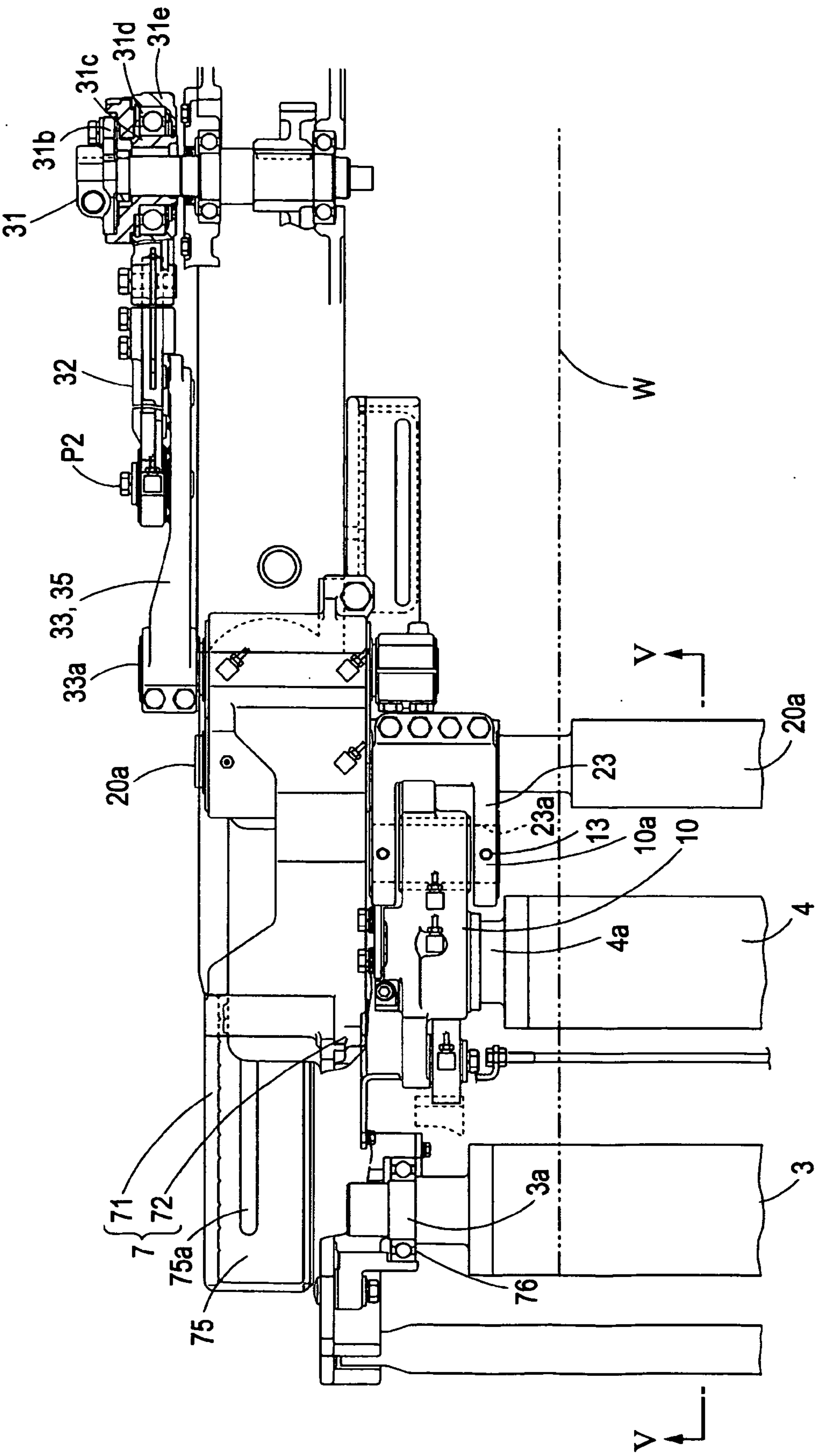
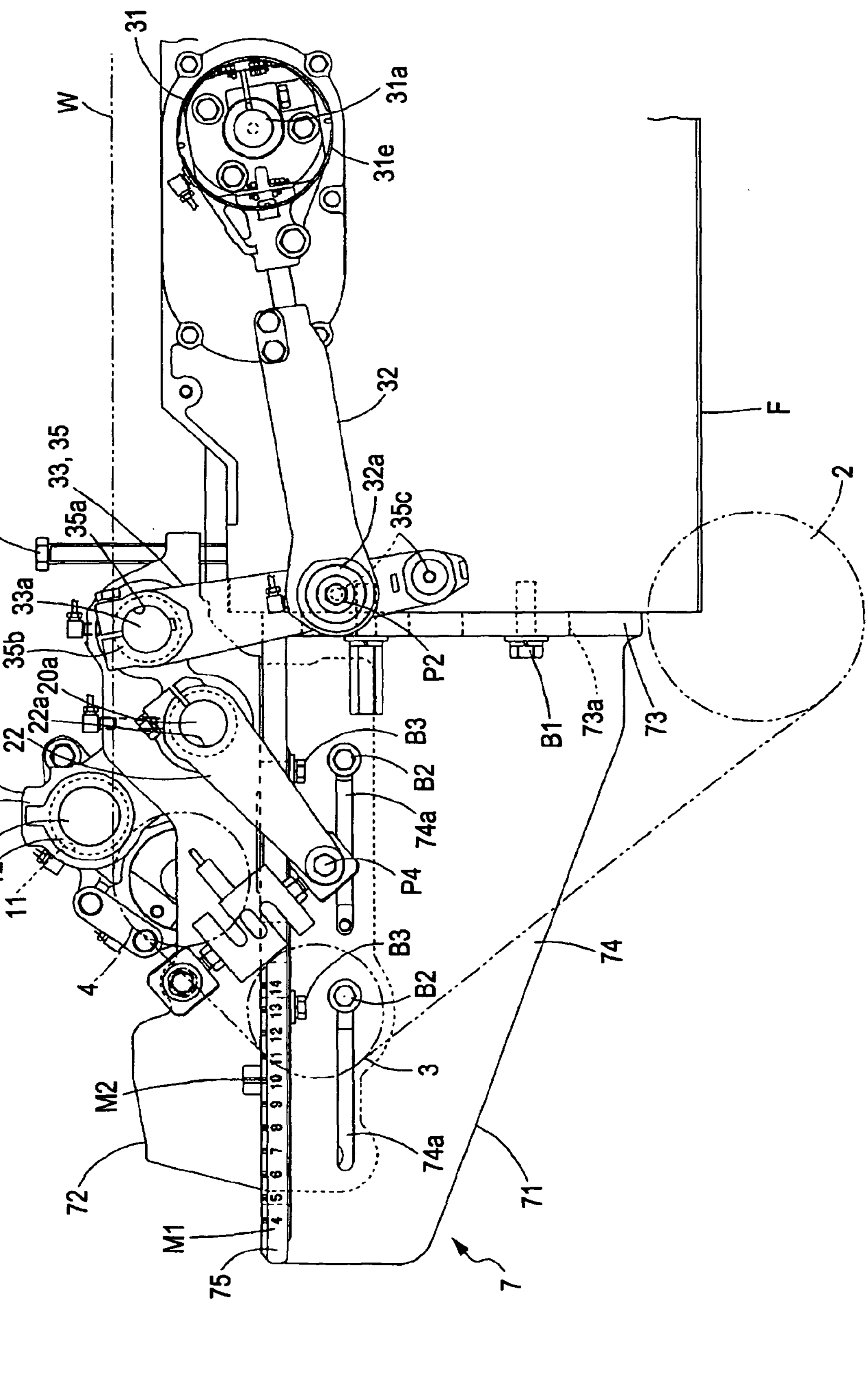

31e
31d
31c
31b
31a
31
W
F
32
P2
76
33, 35
20, 21
33a
IV
20a
20a
11
12
13
10a
10
23a
23
22
62
P4
61
4
4a
P5
63
3
3a
77
72
71
7
75a
75

FIG. 3



31
31b
31c
31d
31e
32
P2
33, 35
33a
20a
W
V
20a
23
23a
13
10a
10
4
4a
3
3a
76
75
75a
7
71
72
V

FIG. 4



31
31a
31e
W
F
32
32a
33, 35
35a
35b
35c
33a
76
P2
B1
73a
73
2
20a
22a
22
20, 21
23
10a
12
11
B3
B2
74a
P4
74
4
3
M2
72
M1
75
71
7

FIG. 5

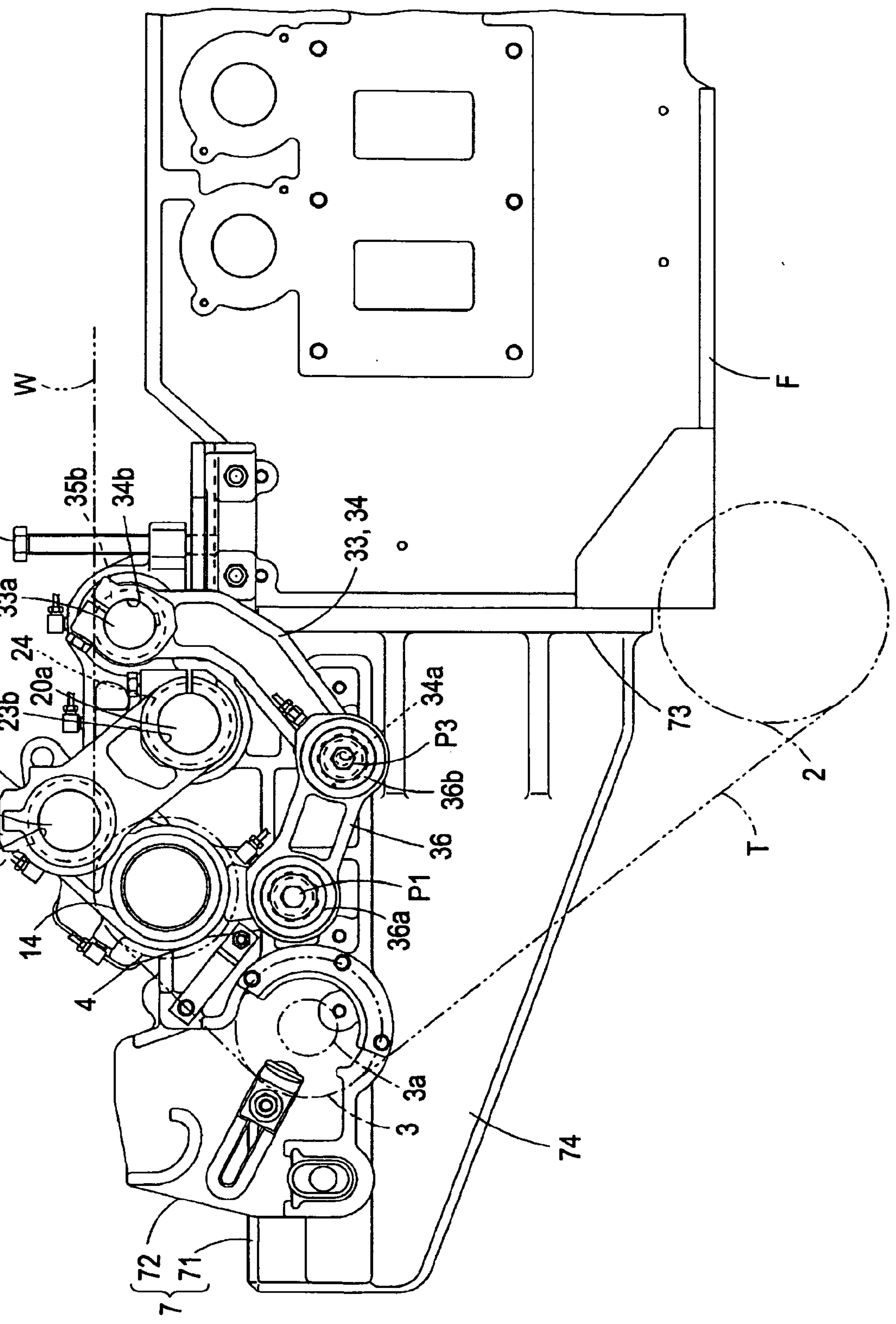

W
76
35b
34b
33, 34
33a
24
20, 21
20a
23b
34a
P3
36b
23
10a
23a
12
36
P1
36a
14
4
3a
3
74
72
71
7
73
2
T
F

FIG. 6

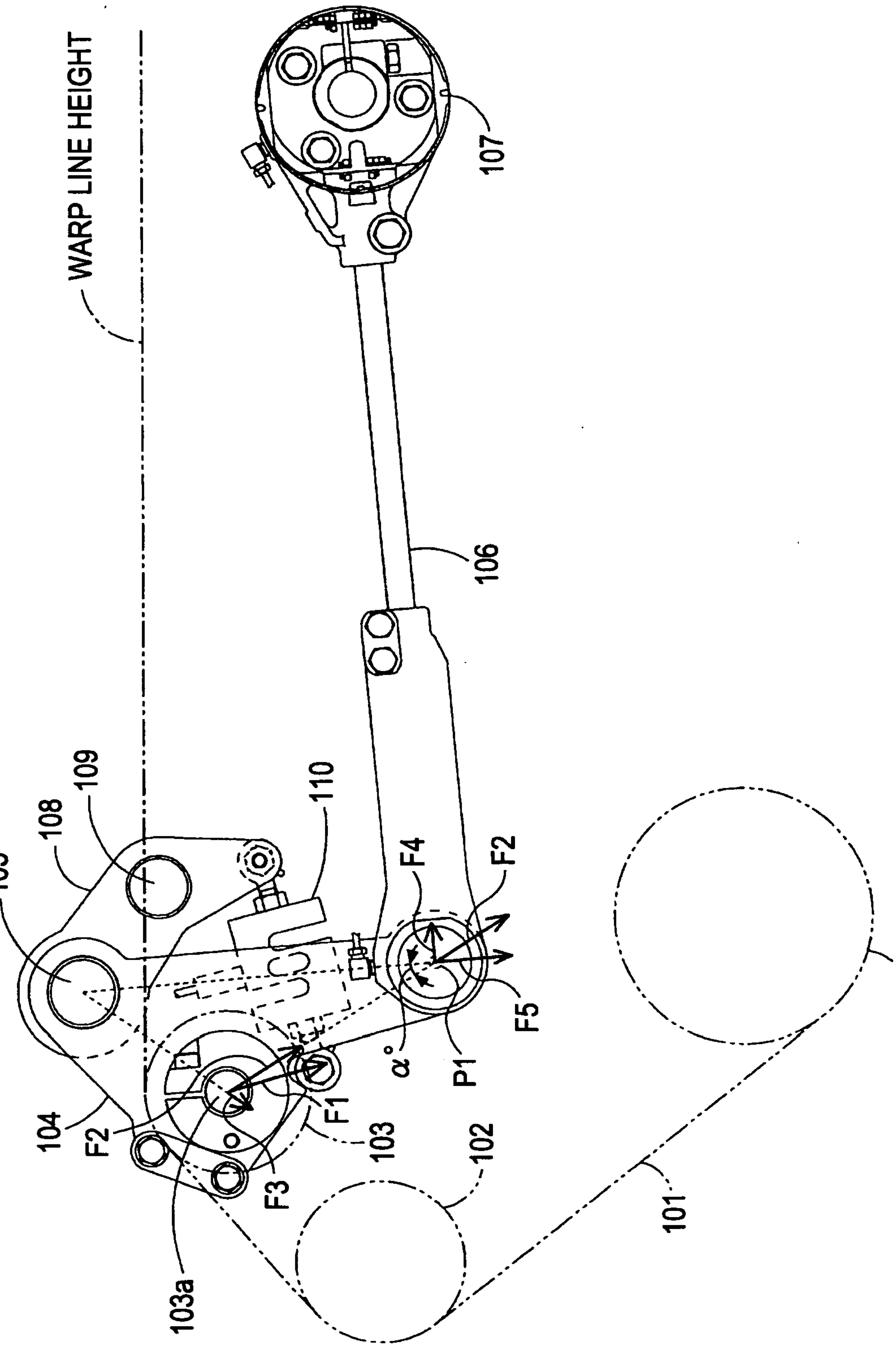

WARP LINE HEIGHT
107
106
105
108
109
110
F4
F2
F5
P1
α°
104
F2
F1
103
F3
102
103a
100
101

FIG. 7

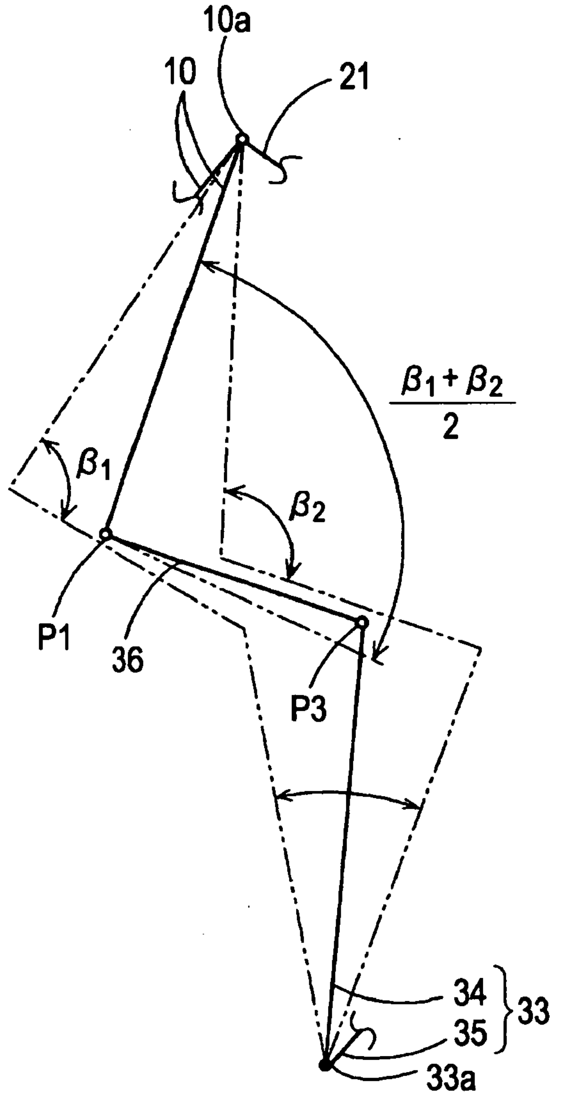
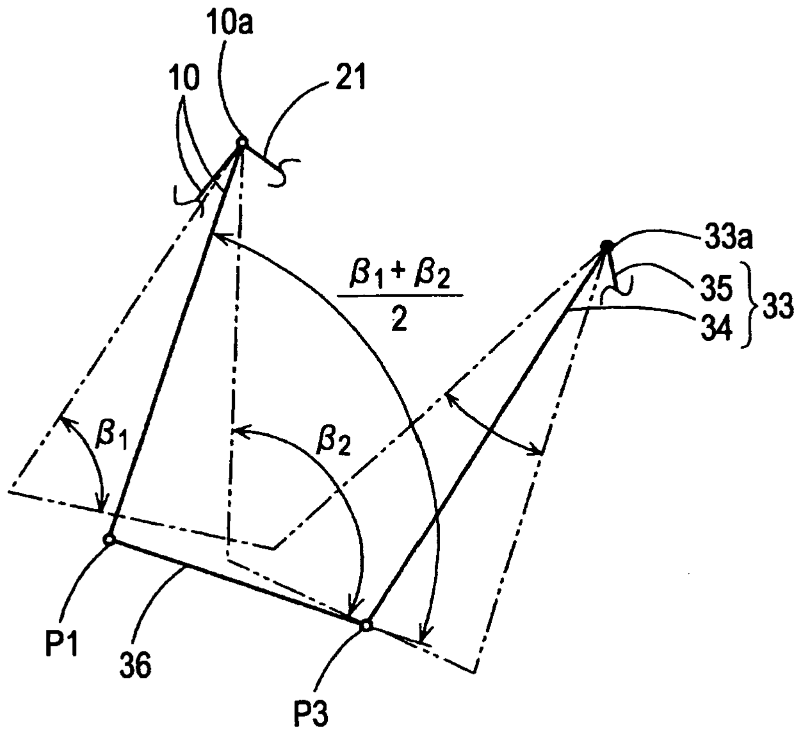


FIG. 8



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 09 01 3172

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 1 878 821 A (TSUDAKOMA IND CO LTD [JP]) 16 January 2008 (2008-01-16) * figure 6 * -----	1-9	INV. D03D49/12
A	EP 0 547 003 A (TOYODA AUTOMATIC LOOM WORKS [JP]) 16 June 1993 (1993-06-16) * figures 1-3 * -----	1-9	
A	EP 0 527 705 A (TOYODA AUTOMATIC LOOM WORKS [JP]) 17 February 1993 (1993-02-17) * figures 1-3 * -----	1-9	
A	JP 09 228195 A (TOYODA AUTOMATIC LOOM WORKS) 2 September 1997 (1997-09-02) * abstract; figures 1-6 * -----	1-9	
A	EP 1 544 338 A (TOYOTA JIDOSHOKKI KK [JP]) 22 June 2005 (2005-06-22) * figures 1-5 * -----	1-9	
A	JP 56 154541 A (NISSAN MOTOR) 30 November 1981 (1981-11-30) * abstract; figures 1,2 * -----	1-9	TECHNICAL FIELDS SEARCHED (IPC) D03D
P,A	CN 201 224 808 Y (WEIFANG JINSHUAI MACHINERY CO [CN]) 22 April 2009 (2009-04-22) * figures 1,2 * -----	1-9	

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	19 January 2010	Iamandi, Daniela

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
& : member of the same patent family, corresponding document

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 01 3172

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-01-2010

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 1878821	A	16-01-2008	CN	101104976 A	16-01-2008
			JP	2008019516 A	31-01-2008
EP 0547003	A	16-06-1993	JP	2534202 Y2	30-04-1997
			JP	5051988 U	09-07-1993
EP 0527705	A	17-02-1993	JP	5051845 A	02-03-1993
JP 9228195	A	02-09-1997	JP	3508372 B2	22-03-2004
EP 1544338	A	22-06-2005	CN	1523147 A	25-08-2004
			JP	2004250817 A	09-09-2004
JP 56154541	A	30-11-1981	JP	1281785 C	13-09-1985
			JP	60007739 B	26-02-1985
CN 201224808	Y	22-04-2009	NONE		

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2008019516 A **[0003]**