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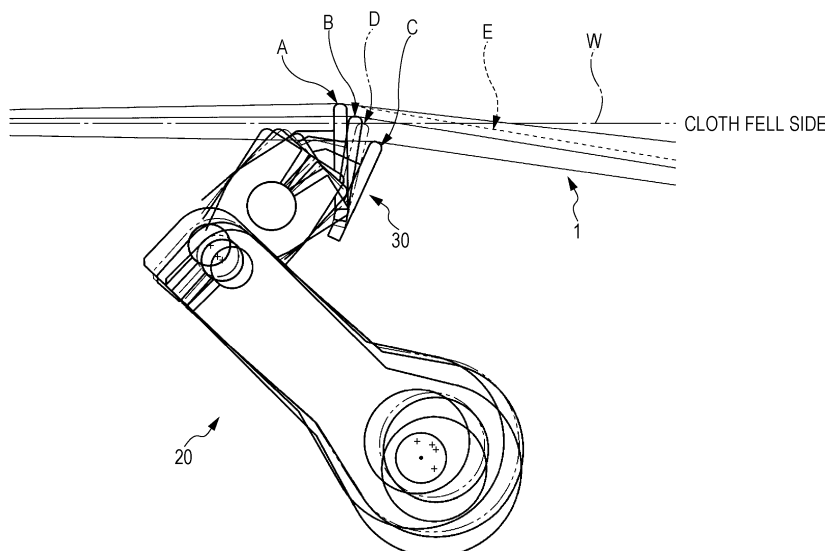
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(54) **Warp bending device for loom**

(57) A warp bending device (20) is included in a loom that includes a dropper-type warp breakage detection device (6) disposed on a warp-let-off side of heald frames and which is set such that a time at which warp yarns (1), which are caused to perform a shedding motion by the heald frames, are set to a shed closed state differs from a beating time at which a weft yarn is beaten against a cloth fell by a reed. The warp bending device (20) includes a warp bending member (30) that is disposed between the dropper-type warp breakage detection device

(6) and the heald frames in a warp direction and above or below a row of the warp yarns (1) in a vertical direction and that extends over a region of the row of the warp yarns (1) in a weaving-width direction, the warp bending member (30) being positioned such that the warp bending member (30) is in contact with one of an upper warp yarn row and a lower warp yarn row of the warp yarns (1) that are in a shed open state and bends a path of the one of the upper and lower warp yarn rows at least at the beating time.

FIG. 6



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a warp bending device for a loom that includes a dropper-type warp breakage detection device disposed on a warp-let-off side of heald frames. The loom is set such that the time at which warp yarns, which are caused to perform a shedding motion by the heald frames, are set to a shed closed state differs from a beating time at which a weft yarn is beaten against a cloth fell by a reed.

2. Description of the Related Art

[0002] An example of a commonly known loom includes a dropper-type warp breakage detection device (hereinafter may be referred to as a "dropper device") disposed on a warp-let-off side of the heald frames, that is, between a tension roller and the heald frames (see, for example, Japanese Unexamined Patent Application Publication No. 2013-83019). The dropper device has a well-known structure and includes the same number of dropper pins as the number of warp yarns that extend from a warp beam. Each dropper pin has a hole through which the corresponding warp yarn is inserted so that the dropper pin is supported by the warp yarn. When a warp yarn breaks, the corresponding dropper pin falls so that warp breakage can be detected. Although the dropper device is provided to detect warp breakage as described above, effects of leasing and fluff cutting can also be provided for the warp yarns that extend from the warp beam.

[0003] A general dropper device includes so-called oval tubes having an oval shape in cross section at locations in front of and behind a row of dropper pins, and at least the oval tube at the back side (heald-frame side) regulates a path of lower warp yarns (lower warp yarn row) among the warp yarns that are in a shed open state (see Fig. 7 of Japanese Unexamined Patent Application Publication No. 2013-83019). With this structure, the dropper device further provides an effect of improving weft picking performance (hereinafter may be referred to simply as "picking performance"). This will be described in more detail below.

[0004] With looms, it is known that the picking performance can be increased when there is a difference between tensions applied to the upper and lower warp yarn rows (see, for example, Japanese Unexamined Patent Application Publication No. 54-131073). In addition, in a loom that is set such that the time at which warp yarns, which are caused to perform a shedding motion by the heald frames, are set to a shed closed state differs from the time at which a weft yarn is beaten against a cloth fell by a reed, the shed formed by the warp yarns is not closed (the warp yarns are not set to a shed closed state)

and is slightly open at the beating time. Among the upper and lower warp yarn rows of the open shed, the path of the lower warp yarn row is regulated by an oval tube included in a dropper device as described above. Accordingly, the lower warp yarn row is bent, so that a tension difference is generated between the upper and lower warp yarn rows and the picking performance is improved. The weft picking performance affects the quality of woven cloth. If the picking performance is low, the cloth becomes slack at the beating time, and the quality of the woven cloth is degraded.

[0005] It has been found that the above-described effects of leasing and fluff cutting for the warp yarns provided by the dropper device can be enhanced by shifting the dropper device toward the warp-let-off side (toward the tension roller). In addition, the dropper device is preferably near the warp-let-off side also from the viewpoint of work efficiency in a restoration process performed for a warp breakage.

[0006] However, when the dropper device is shifted toward the warp-let-off side, the distance between the oval tube included in the dropper device and the heald frames increases, and the degree of bending of the lower warp yarn row by the oval tube decreases. Therefore, the tension difference between the upper and lower warp yarn rows generated by bending the lower warp yarn row decreases. As a result, the picking performance cannot be increased to a desired level.

SUMMARY OF THE INVENTION

[0007] With regard to the above-described loom, an object of the present invention is to arrange the dropper device so that the effects of leasing and fluff cutting for the warp yarns can be provided and, at the same time, to set a tension difference between the upper and lower warp yarn rows at the beating time such that desired weft picking performance can be obtained.

[0008] A warp bending device according to the present invention is included in a loom that includes a dropper-type warp breakage detection device disposed on a warp-let-off side of heald frames and which is set such that a time at which warp yarns, which are caused to perform a shedding motion by the heald frames, are set to a shed closed state differs from a beating time at which a weft yarn is beaten against a cloth fell by a reed.

[0009] The warp bending device according to the present invention includes a warp bending member that is disposed between the dropper-type warp breakage detection device and the heald frames in a warp direction and above or below a row of the warp yarns in a vertical direction and that extends over a region in which the row of the warp yarns extends in a weaving-width direction, the warp bending member being positioned such that the warp bending member is in contact with one of an upper warp yarn row and a lower warp yarn row of the warp yarns that are in a shed open state and bends a path of the one of the upper and lower warp yarn rows at least

at the beating time.

[0010] Here, "at least at the beating time" means that the time is not limited as long as at least beating time is included. For example, as in an embodiment described below, the warp bending member may be in contact with and bend the one of the upper and lower warp yarn rows over the entire period in which a main shaft of the loom rotates one revolution.

[0011] In the warp bending device according to the present invention, the warp bending member may be fixed. However, more preferably, a driving mechanism that reciprocates the warp bending member in the vertical direction may be provided. When the one of the upper and lower warp yarn rows moves toward a maximum displacement position during the shedding motion after the beating time, the driving mechanism may drive the warp bending member so that the warp bending member moves in a direction of movement of the one of the upper and lower warp yarn rows.

[0012] The "maximum displacement position" is a position farthest from a warp line (position of the warp yarns in a shed closed state) on a path along which the warp yarns move in the shedding motion. The maximum displacement position is the lowermost position for the lower warp yarn row, and the uppermost position for the upper warp yarn row.

[0013] In the case where the warp bending device according to the present invention includes the driving mechanism, preferably, the driving mechanism drives the warp bending member so that a degree of bending by the warp bending member at a time when the one of the upper and lower warp yarn rows is at the maximum displacement position is smaller than or equal to a degree of bending by the warp bending member at the beating time.

[0014] The "degree of bending (of the one of the upper and lower warp yarn rows) by the warp bending member" is not limited to the case in which the one of warp yarn rows is bent, and a case in which the warp yarn row is not bent by the warp bending member is also included.

[0015] The warp bending device according to the present invention includes the warp bending member that is closer to the heald frames than the warp breakage detection device is. At the beating time, the warp bending member bends one of the upper and lower warp yarn rows in a shed open state, so that a tension difference is generated between the upper and lower warp yarn rows. Therefore, the warp breakage detection device can be arranged in the warp direction such that the effects of leasing and fluff cutting for the warp yarns can be provided, and the weft picking performance can be increased at the beating time.

[0016] The driving mechanism that reciprocates the warp bending member, which bends the one of the upper and lower warp yarn rows at the beating time, in the vertical direction may be provided, and, when the one of the upper and lower warp yarn rows moves toward a maximum displacement position during the shedding motion

after the beating time, the driving mechanism may drive the warp bending member so that the warp bending member moves in a direction of movement of the one of the upper and lower warp yarn rows. In this case, the one of the upper and lower warp yarn rows can be bent (a tension difference can be generated between the upper and lower warp yarn rows) by the warp bending member so that the weft picking performance can be increased at the beating time, and the one of the upper and lower warp yarn rows can be prevented from receiving an excessive tension when the warp yarns are in a maximum shed state. This will be described in more detail below.

[0017] The shed formed by the warp yarns at the beating time is, of course, smaller than the shed formed by the warp yarns when the warp yarns are in a maximum shed state. Therefore, in the case where the warp bending member is fixed at a position where the warp bending member bends the one of the upper and lower warp yarn rows at the beating time, when the one of the upper and lower warp yarn rows moves toward the maximum displacement position during the shedding motion, the degree of bending (bending amount) increases accordingly. When the bending amount increases, the tension increases accordingly. Even when neither of the upper and lower warp yarn rows is bent by the warp bending member as described above, the tension applied to the upper and lower warp yarn rows increases as the area of the shed (displacement) increases. Therefore, in the case where the warp bending member is fixed as described above, even if a desired tension is applied to the one of the upper and lower warp yarn rows at the beating time, the tension increases by a large amount as the one of the upper and lower warp yarn rows moves toward the maximum displacement position and the bending amount increases accordingly. Thus, there is a risk that an excessive tension will be applied. When an excessive tension is applied, depending on the weaving conditions (e.g., the set tension of the warp yarns), the type of the warp yarns, etc., there is a risk that the weaving operation will be adversely affected and the quality of the woven cloth will be reduced. In addition, there is also a risk that the one of the upper and lower warp yarn rows will break.

[0018] In contrast, when the warp bending member is moved in the vertical direction by the driving mechanism in accordance with the movement of the one of the upper and lower warp yarn rows toward the maximum displacement position (in the direction of movement of the one of the upper and lower warp yarn rows), the increase in the bending amount of the one of the upper and lower warp yarn rows can be suppressed. As a result, the increase in the tension applied to the one of the upper and lower warp yarn rows can be suppressed.

[0019] The driving mechanism may drive the warp bending member so that the degree of bending by the warp bending member at a time when the one of the upper and lower warp yarn rows is at the maximum displacement position is smaller than or equal to the degree of bending by the warp bending member at the beating

time. In this case, the one of the upper and lower warp yarn rows is prevented from receiving an excessive tension, so that the weft picking performance can be increased and the weaving operation can be stabilized at the same time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Fig. 1 is a schematic side view of a loom to which the present invention is applied;

Fig. 2 is a graph showing shedding curves of the loom to which the present invention is applied;

Fig. 3 is a perspective view of an example of a warp bending device according to the present invention;

Fig. 4 is a side view of the example of the warp bending device according to the present invention;

Fig. 5 is a side view illustrating the state of warp yarns at a beating time; and

Fig. 6 is a side view that illustrates, together with the warp yarns, the manner in which a warp bending member, included in the example of the warp bending device according to the present invention, swings.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Fig. 1 is a schematic diagram illustrating a loom to which the present invention is applied. In this loom, warp yarns 1 are let off from a warp beam 2 around which the warp yarns 1 are wound, and are successively wound around a guide roller 3 that guides the warp yarns (row of the warp yarns that are arranged next to each other in a horizontal direction) 1 and a tension roller 5 to which a tension sensor 4 is connected. Thus, the warp yarns 1 are caused to extend toward the cloth fell and reach a dropper-type warp breakage detection device 6, that is, a dropper device 6, for detecting a warp breakage.

[0022] The dropper device 6 includes a pair of oval tubes 6a and 6c and the same number of dropper pins 6b as the number of warp yarns 1. The dropper pins 6b are disposed between the oval tubes 6a and 6c. The warp yarns 1 extend above the oval tube 6a at the tension-roller-5 side (back side), and are inserted through holes formed in the respective dropper pins 6b, so that each dropper pin 6b is supported by the corresponding warp yarn 1. Therefore, when a warp yarn 1 breaks, the corresponding dropper pin 6b falls due to its own weight so that warp breakage can be detected by the dropper device 6. The warp yarns 1 that have passed through the dropper pins 6b extend toward heald frames (not shown) above the oval tube 6c that is farther from the tension roller 5 than the dropper pins 6b are (at the front side). In the illustrated example, the oval tubes 6c and 6a at the front and back sides, respectively, both have an oval shape in cross section. Among an upper warp yarn row 1 and a lower warp yarn row 1 of the warp yarns 1 that

are in a shed open state, downward movement of the lower warp yarn row 1 is regulated by the oval tubes 6c and 6a.

[0023] The warp yarns (row of warp yarns) 1 that have passed through the dropper device 6 are inserted through healds 7a attached to the heald frames (not shown) that are arranged next to each other, and extend to a cloth fell 8. Thus, the warp yarns 1 are moved in a vertical direction in accordance with the vertical movements (shedding motion) of the heald frames (healds 7a), thereby forming a shed. A weft yarn 9 is inserted through the shed formed by the warp yarns 1, and the weft yarn 9 that has been inserted is beaten against the cloth fell 8 by a reed 11, so that the weft yarn 9 is interwoven with the warp yarns 1. Thus, cloth 14 is formed (woven). The woven cloth 14 passes around a cloth roller 12 and other rollers, and is wound onto a cloth roller 13.

[0024] Fig. 2 is a graph showing an example of shedding curves (shedding patterns) representing the drive patterns of the heald frames. The graph shows the relationship between the rotational angle (crank angle) of a main shaft (not shown) of the loom and the positions of the heald frames in the vertical direction. The heald frames of the loom are driven in accordance with the drive patterns represented by the shedding curves. The shedding curves of the heald frames illustrated in Fig. 2 are those for weaving plain-weave cloth. Among the heald frames, the odd-numbered heald frames counted from the cloth fell 8 are driven in accordance with the drive pattern corresponding to one of the two shedding curves shown in Fig. 2, and the even-numbered heald frames counted from the cloth fell 8 are driven in accordance with the drive pattern corresponding to the other one of the two shedding curves shown in Fig. 2. In the loom to which the present invention is applied, as illustrated in Fig. 2, the time at which the warp yarns 1 are set to a shed closed state (time at which the two shedding curves intersect in Fig. 2 (crank angle 300° in the illustrated example)) differs from the time at which the inserted weft yarn is beaten against the cloth fell 8 (generally crank angle 0° (360°)). Therefore, at the beating time, the warp yarns 1 are in the shed open state.

[0025] The above-described loom includes a warp bending device 20 according to the present invention. In the present embodiment, as illustrated in Figs. 3 and 4, the warp bending device 20 includes a warp bending member 30 that bends the lower warp yarn row 1 and a driving mechanism 40 that reciprocates the warp bending member 30 in the vertical direction.

[0026] The driving mechanism 40 of the illustrated example is an eccentric crank mechanism, and includes a rotating shaft 50 that is arranged so as to extend between a pair of frames (not shown) of the loom and to which the warp bending member 30 is attached; swing levers 60 that are attached to both end portions of the rotating shaft 50 such that the swing levers 60 are not rotatable with respect to the rotating shaft 50; and crank levers 70 that connect the swing levers 60 to drive shafts 80 and that

cause the swing levers 60 to swing in response to rotation of the drive shafts 80. According to the present embodiment, it is assumed that the structures of portions of the driving mechanism 40 at both ends of the rotating shaft 50 are the same except that the arrangements thereof are symmetrical in the weaving-width direction. Therefore, in Figs. 3 and 4, the structure of a portion at only one end of the rotating shaft 50 is illustrated, and only the structure at that end will be described.

[0027] As described above, the rotating shaft 50 extends between the pair of frames. In the illustrated example, the rotating shaft 50 is supported at each end by a bracket 51 fixed to the corresponding frame and a stay 52 fixed to the bracket 51. The rotating shaft 50 is supported by the stay 52 with a bearing 53 disposed therebetween, the bearing 53 being fitted to the end of the rotating shaft 50. Thus, the rotating shaft 50 is rotatable while being supported in the above-described manner. The rotating shaft 50 extends between the pair of frames in the weaving-width direction (axial direction), as described above. In the present embodiment, the rotating shaft 50 is disposed below a warp line (path of the warp yarns 1 in the shed closed state in a side view of the loom) W in the vertical direction. Also, the rotating shaft 50 is disposed between the dropper device 6 and the heald frames at substantially the middle point between the front oval tube 6c of the dropper device 6 and the heald frame that is farthest from the cloth fell 8 in a warp direction.

[0028] Each swing lever 60 is non-rotatably attached to the rotating shaft 50 at a position near the position where the rotating shaft 50 is supported by the bracket 51. The swing lever 60 will be described in more detail below.

[0029] The swing lever 60 has a through hole 61 at a position shifted from the center of the swing lever 60 toward one end of the swing lever 60 in the longitudinal direction thereof. The diameter of the through hole 61 is substantially the same as that of the rotating shaft 50. A slot 62a is formed in the swing lever 60 so as to extend from the end of the swing lever 60 to the through hole 61. Thus, the swing lever 60 includes a split clamp structure 62 including the slot 62a. The rotating shaft 50 is inserted through the through hole 61 and clamped by the split clamp structure 62, so that the swing lever 60 is non-rotatably fixed to the rotating shaft 50.

[0030] The swing lever 60 is disposed at a position near the position where the rotating shaft 50 is supported (position of the frame) in the weaving-width direction (axial direction of the rotating shaft 50), and is on the outer side (frame side) of the row of the warp yarns for weaving a cloth having a maximum width that can be woven by the loom. The swing lever 60 also has a through hole 63 at an end opposite to the end at which the through hole 61 is formed. The through hole 63 extends through the swing lever 60 in the same direction as the direction in which the through hole 61 extends. In other words, the through hole 63 has an axis that is parallel to that of the

through hole 61. A connecting shaft 65, which connects the swing lever 60 and the crank lever 70 to each other, is rotatably inserted through the through hole 63 with a bearing 64 provided therebetween.

[0031] The crank lever 70 is connected to the corresponding drive shaft 80 at one end thereof in the longitudinal direction, and is connected to the swing lever 60 at the other end thereof by the connecting shaft 65. The drive shaft 80 is provided on the frame, and is supported such that the drive shaft 80 is rotatable with respect to the frame. The drive shaft 80 is connected to the main shaft of the loom by driving-force transmitting means (not shown) including gears, and is rotated one revolution each time the main shaft is rotated one revolution. The crank lever 70 will be described in more detail below.

[0032] The crank lever 70 has a through hole 71 at one end thereof, the through hole 71 extending through the crank lever 70 in the thickness direction. The crank lever 70 is rotatably attached to an end portion (axial end portion 80a) of the drive shaft 80 with a bearing 72 interposed therebetween, the bearing 72 being fitted in the through hole 71. The bearing 72, which is fitted in the through hole 71 in the crank lever 70, is an eccentric bearing (eccentric collar bearing) including an eccentric collar 72a. Thus, the crank lever 70 is attached to the drive shaft 80 at one end thereof such that the center 71Y of the through hole 71 is shifted from the axis 80X of the drive shaft 80.

[0033] In the illustrated example, the drive shaft 80 has a so-called stepped shape and includes a stepped portion (not shown) so that the diameter of the axial end portion 80a to which the crank lever 70 is attached is smaller than that of other portions. The length of the axial end portion 80a is greater than the thickness of the crank lever 70. In the state in which the crank lever 70 is attached to the drive shaft 80 such that the crank lever 70 is in contact with the stepped portion, the axial end portion 80a projects from the crank lever 70 in the axial direction of the drive shaft 80 (thickness direction of the crank lever 70).

[0034] A positioning collar 73 is attached to a portion of the axial end portion 80a of the drive shaft 80 that projects from the crank lever 70 (hereinafter referred to as a "projecting portion") by a fixing member 74, to which the positioning collar 73 is fixed with screw members 75. More specifically, the projecting portion is inserted through a through hole (not shown) formed in the positioning collar 73 and a through hole 74a formed in the fixing member 74 so that the positioning collar 73 and the fixing member 74 are arranged in the axial direction of the drive shaft 80. In addition, the projecting portion is clamped by a split clamp structure 74c including a slot 74b that extends to the through hole 74a in the fixing member 74, so that the fixing member 74 is attached to the projecting portion. The positioning collar 73 is fixed to the fixing member 74 with the screw members 75. Thus, the position of the crank lever 70 on the axial end portion 80a in the axial direction of the drive shaft 80 is

regulated by the positioning collar 73 fixed to the drive shaft 80 (axial end portion 80a) and the step portion of the drive shaft 80.

[0035] The crank lever 70 has a through hole 76 at an end opposite to the end at which the through hole 71 is formed. Similar to the through hole 71, the through hole 76 extends through the crank lever 70 in the thickness direction thereof. A slot 77a is formed in the crank lever 70 so as to extend from the end at which the through hole 76 is formed to the through hole 76. Thus, the crank lever 70 includes a split clamp structure 77 including the slot 77a. The connecting shaft 65, which is attached to the swing lever 60, is inserted through the through hole 76 and clamped by the split clamp structure 77, so that the crank lever 70 is non-rotatably attached to the connecting shaft 65. Thus, the crank lever 70 is connected to the swing lever 60 through the connecting shaft 65.

[0036] As described above, in the driving mechanism 40, the swing lever 60 is non-rotatably attached to the rotating shaft 50 at one end thereof, the rotating shaft 50 being rotatably supported between the pair of frames. Thus, the swing lever 60 is swingable around the axis of the rotating shaft 50.

[0037] The other end of the swing lever 60 is attached to the connecting shaft 65, to which the crank lever 70 is non-rotatably attached. An end portion of the crank lever 70 at an end opposite to the end at which the crank lever 70 is connected to the swing lever 60 is connected to the drive shaft 80. Thus, the swing lever 60 is connected to the drive shaft 80 through the connecting shaft 65 and the crank lever 70. The crank lever 70 is assembled to the drive shaft 80 such that the center 71Y of the through hole 71 that is formed in the end portion of the crank lever 70 and to which the bearing 72 is fitted is shifted from the axis 80X of the drive shaft 80. Therefore, when the drive shaft 80 rotates, the end portion of the crank lever 70 performs an eccentric motion, and accordingly the swing lever 60 swings around the axis of the rotating shaft 50 in a reciprocating manner. As a result, the rotating shaft 50, which is non-rotatably attached to the swing lever 60, is rotated in a reciprocating manner within an angular range that corresponds to the amount by which the swing lever 60 swings.

[0038] In the present embodiment, as illustrated, the warp bending member 30 is a plate-shaped member. In the loom, the plate-shaped warp bending member 30 is attached to the rotating shaft 50 included in the above-described driving mechanism 40 such that the longitudinal direction thereof is the same as the axial direction of the rotating shaft 50. Thus, the warp bending member 30 is supported below the warp line W and disposed below the row of the warp yarns in the vertical direction, and is disposed between the heald frames and the dropper device 6 (substantially at the middle point between the front oval tube 6c of the dropper device 6 and the heald frame that is farthest from the cloth fell) in the warp direction. The dimension of the warp bending member 30 in the longitudinal direction is greater than the maxi-

mum weaving width of the loom. The warp bending member 30 is attached to the rotating shaft 50 so that the center thereof in the longitudinal direction substantially coincides with the center of the rotating shaft 50 in the axial direction. Accordingly, the warp bending member 30 extends over a range of the row of the warp yarns in the weaving-width direction.

[0039] The warp bending member 30 is attached to the rotating shaft 50 with attachment members 31 at a plurality of positions in the weaving-width direction. More specifically, the attachment members 31 are fixed to the rotating shaft 50 at a plurality of positions with predetermined intervals therebetween in the axial direction. The warp bending member 30 is attached to the rotating shaft 50 by fastening screw members 32 to the attachment members 31. The attachment members 31 are attached to the rotating shaft 50 by using, for example, split clamp structures formed thereon. When the rotating shaft 50 included in the driving mechanism 40 is caused to rotate in a reciprocating manner as described above, the warp bending member 30 swings around the axis of the rotating shaft 50 in a reciprocating manner.

[0040] In the present embodiment, the warp bending device 20 including the driving mechanism 40 and the warp bending member 30 are configured as follows. That is, the warp bending member 30 reaches the uppermost position (top dead center of the warp bending member 30 driven by the crank mechanism, shown by the solid lines in Fig. 4) at the beating time (crank angle 0°), and reaches the lowermost position (bottom dead center of the warp bending member 30 driven by the crank mechanism, shown by the two-dot chain lines in Fig. 4) when the crank angle is 180°.

[0041] The position at which the warp bending member 30 is attached to the rotating shaft 50 when the warp bending member 30 is at the uppermost position (crank angle 0°), for example, is set in accordance with the position of the lower warp yarn row, which is bent by the upper edge of the warp bending member 30, at the beating time so that the lower warp yarn row is bent to a desired degree (by a desired bending amount) at which a desired tension difference is generated between the upper and lower warp yarn rows 1. The amount by which the warp bending member 30 swings back and forth (amount by which the rotating shaft 50 rotates back and forth) is determined by the amount of eccentricity of the through hole 71 in the crank lever 70 with respect to the drive shaft 80 in the driving mechanism 40. The amount of eccentricity is set so that the warp bending member 30 that has been at the uppermost position at the beating time swings to a position where the lower warp yarn row does not receive an excessive tension when the lower warp yarn row is moved by a maximum distance (when the lower warp yarn row is at the lowermost position).

[0042] In the present embodiment, also when the warp bending member 30 is at the lowermost position, the warp bending member 30 is positioned with respect to the lower warp yarn row so as to be in contact with and bend

the lower warp yarn row. In other words, when the warp bending member 30 that has been at the uppermost position at the beating time swings by an amount corresponding to the amount of eccentricity and reaches the lowermost position, the upper edge of the warp bending member 30 is above the path of the lower warp yarn row in the case where the path is not regulated by the warp bending member 30 when the crank angle is 180°. Therefore, the warp bending member 30 is in contact with and bends the lower warp yarn row over the entire period in which the main shaft rotates one revolution. The amount by which the warp bending member 30 swings is set so that, when the lower warp yarn row is moved by the maximum distance, the warp bending member 30 is at a position where the lower warp yarn row that is bent by the warp bending member 30 do not receive an excessive tension. In the warp bending device 20 in which the uppermost position of the warp bending member 30 and the amount by which the warp bending member 30 swings are set as described above, in the present embodiment, the upper edge of the warp bending member 30 is at the height of the warp line W when the rotational position of the rotating shaft 50 corresponds to the crank angle of 90°. Therefore, in a period in which the crank angle is in the range of 0° to 90°, the upper edge of the warp bending member 30 is above the warp line W.

[0043] Fig. 5 illustrates the state of the warp yarns 1 at the beating time. In Fig. 5, the front oval tube 6c is the only component of the dropper device 6 that is illustrated. The one-dot chain lines show paths 1c and 1d of the upper and lower warp yarn rows in the maximum shed state in the case where the warp bending device (warp bending member) according to the present invention is not provided. The dotted lines in the region on the warp-let-off side (tension-roller-5 side) of the heald frames (healds 7a) show a path 1e of the lower warp yarn row in the case where the warp bending device (warp bending member) according to the present invention is not provided.

[0044] As illustrated in Fig. 5, with the loom which includes the above-described warp bending device 20 and in which the dropper device 6 is disposed near the tension roller 5 so that the desired effects of leasing and the like can be obtained, compared to the case in which the path of the lower warp yarn row is regulated in the vertical direction at the warp-let-off side of the heald frames only by the oval tube 6c included in the dropper device 6, the lower warp yarn row can be more reliably bent. Accordingly, the tension difference between the upper and lower warp yarn rows can be set such that the desired picking performance can be obtained. In addition, with the warp bending device 20 according to the present embodiment, the lower warp yarn row is bent, and the warp bending member 30 swings downward in accordance with the downward movement of the lower warp yarn row during the shedding motion of the warp yarns 1. Therefore, the lower warp yarn row can be prevented from receiving an excessive tension when the lower warp yarn row is

moved downward by a maximum distance, and problems such as breakage of the lower warp yarn row due to the excessive tension can be prevented. This will be described in more detail.

[0045] As described above, according to the shedding curves illustrated in Fig. 2 based on which the heald frames are driven in the present embodiment, the lower warp yarn row is at the lowermost position in a period in which the crank angle is in the range of about 70° to about 165°. Fig. 6 illustrates, together with the lower warp yarn row 1, the manner in which the warp bending member 30 of the warp bending device 20 swings. Four states (positions A, B, C, and D) of the warp bending member 30 that swings are shown by three solid lines and a single two-dot chain line. Position A, which is shown by a solid line, corresponds to the state of the warp bending device 20 (position of the warp bending member 30) in which the warp bending member 30 is at the uppermost position (crank angle 0°). Position B, which is shown by another solid line, corresponds to the state of the warp bending device 20 (position of the warp bending member 30) when the crank angle is 70°. Position C, which is shown by another solid line, corresponds to the state of the warp bending device 20 (position of the warp bending member 30) when the crank angle is 165°. Position D, which is shown by the two-dot chain line, corresponds to the state of the warp bending device 20 (position of the warp bending member 30) when the crank angle is 90°. In addition, the dotted line E in Fig. 6 shows the path along which the lower warp yarn row 1 moves when the lower warp yarn row 1 is at the lowermost position in the case where the warp bending member 30 is fixed at position A.

[0046] As illustrated in Fig. 6, in the case where the warp bending member 30 is fixed at position A at which the desired bending amount can be obtained at the beating time (crank angle 0°), as the lower warp yarn row 1 moves downward after the beating time, the bending amount increases and the tension applied to the lower warp yarn row 1 increases accordingly. The tension applied to the lower warp yarn row 1 reaches a maximum when the lower warp yarn row 1 is moved downward by a maximum distance (path shown by the dotted line E). In this state, the tension may be excessive depending on the type of the warp yarns 1 and weaving conditions, and there is a risk that problems such as breakage of the lower warp yarn row 1 will occur.

[0047] In contrast, with the warp bending device 20 according to the present embodiment, when the lower warp yarn row 1 moves downward, the warp bending member 30 also moves downward. Therefore, increase in the bending amount can be suppressed, and the tension applied to the lower warp yarn row 1 when the lower warp yarn row 1 is moved downward by a maximum distance (position B) is lower than that in the case where the warp bending member 30 is fixed at position A. In addition, referring to Fig. 6, during a period in which the lower warp yarn row 1 is at the lower maximum displacement position after reaching that position when the crank

angle is about 70° (period until the crank angle reaches about 165°), the warp bending member 30 is moved downward toward position C, so that the amount by the lower warp yarn row 1 is bent decreases. Therefore, in the illustrated example, the amount by which the lower warp yarn row 1 is bent when the warp bending member 30 is at position B (crank angle 70°) is somewhat greater than the amount by which the lower warp yarn row 1 is bent when the warp bending member 30 is at position A (at the beating time). Accordingly, the tension applied to the lower warp yarn row 1 when the lower warp yarn row 1 reach the lower maximum displacement position is slightly higher than that applied at the beating time. However, this state does not continue, and the tension applied to the lower warp yarn row 1 decreases as the warp bending member 30 moves downward, and becomes lower than that applied at the beating time by the time the warp bending member 30 reaches position C.

[0048] With the above-described warp bending device 20 according to the present embodiment, the tension difference between the upper and lower warp yarn rows 1 at the beating time can be set such that the desired picking performance can be obtained. In addition, problems such as breakage of the lower warp yarn row at the time when the lower warp yarn row is at the lower maximum displacement position (or the excessive tension applied to the lower warp yarn row that causes the problems) can be effectively prevented. In addition, according to the present embodiment, the warp bending member 30 and the rotating shaft 50 that supports the warp bending member 30 are arranged below the warp line (row of warp yarns) W. Therefore, devices included in the loom can be easily arranged, and the warp bending member 30 and the rotating shaft 50 do not serve as obstructions in a restoration process performed for the warp yarns 1 after a yarn breakage. After the warp bending member 30 reaches the lowermost position when the crank angle is 180° as described above, the movement direction thereof is reversed and the warp bending member 30 starts to swing upward. The warp bending member 30 is in contact with all of the warp yarns 1 when the crank angle is 300° and the warp yarns 1 are set to the shed closed state. After that, the warp yarns 1 that had belonged to the upper warp yarn row that formed the warp shed before the shed was closed belong to the lower warp yarn row, and the warp bending member 30 swings so as to bend mainly the lower warp yarn row.

[0049] The warp bending device according to an embodiment of the present invention has been described. However, the present invention is not limited to the above-described embodiment, and various modifications are possible as follows.

[0050] (1) In the above-described embodiment, the warp bending member 30 is disposed below the row of the warp yarns and bends the lower warp yarn row. However, the position of the warp bending member 30 is not limited to a position below the row of the warp yarns as in the embodiment, and the warp bending member 30

may instead be supported above the warp line W and disposed above the row of the warp yarns to bend the upper warp yarn row if structurally possible. In other words, from the viewpoint of improving the picking performance, as long as the desired tension difference is provided between the upper and lower warp yarn rows 1 at the beating time, the picking performance can be increased not only when the lower warp yarn row receives the higher tension but also when the upper warp yarn row receives the higher tension.

[0051] As described above, in the present invention, the position of the warp bending member 30 with respect to the row of the warp yarns in the vertical direction (whether the warp yarn row 1 to be bent is the upper or lower warp yarn row) is not limited. Therefore, in the following description, among an upper warp yarn row and a lower warp yarn row of the warp yarns 1 that form the warp shed, a warp yarn row that is adjacent to the warp bending member 30 in the vertical direction (lower warp yarn row in the above-described embodiment) is referred to as "one of the upper and lower warp yarn rows", and the other warp yarn row is referred to as "the other one of the upper and lower warp yarn rows". It is to be noted that, since the vertical positions of the warp yarns 1 change during the shedding motion, the warp yarns 1 that belong to "one of the upper and lower warp yarn rows" and the warp yarns 1 that belong to "the other one of the upper and lower warp yarn rows" are not constantly the same warp yarns.

[0052] (2) With regard to the driving mechanism 40, in the above-described embodiment, the driving mechanism 40 swings the warp bending member 30 in a reciprocating manner by using an eccentric crank mechanism. However, the driving mechanism 40 is not limited to those using an eccentric crank mechanism. For example, a cam mechanism may instead be used as a structure for swinging the swing lever 60 in the embodiment.

[0053] In addition, in the above-described embodiment, the driving mechanism 40 includes the rotating shaft 50 that rotates in a reciprocating manner, and the warp bending member 30 is attached to the rotating shaft 50. However, the driving mechanism 40 may support the warp bending member 30 without using the rotating shaft 50. For example, when the warp bending member 30 has a high rigidity and the influence of deflection or the like of the warp bending member 30 due to the tension applied to the warp yarns 1 is small, the warp bending member 30 may be supported by the driving mechanism 40 at both ends thereof. In an example of such a structure, levers are fixed to both ends of the warp bending member 30 in the longitudinal direction, and are caused to swing by the driving mechanism 40.

[0054] In addition, in the above-described embodiment, the warp bending member 30 is caused to swing in a reciprocating manner by the driving mechanism 40. However, the driving mechanism 40 is not limited to those that swing the warp bending member 30 in a reciprocating manner, and may instead be configured to linearly recip-

rotate the warp bending member 30 in the vertical direction. In an example of such a structure, the rotating shaft 50 or the warp bending member 30 according to the above-described embodiment may be supported by stays or the like at both ends thereof in the longitudinal direction, and the stays or the like may be linearly moved in the vertical direction by using, for example, a ball screw mechanism or a rack-and-pinion mechanism. The direction of the linear movement is not limited to the vertical direction, and may instead be a direction at an angle with respect to the vertical direction.

[0055] The structure in which the warp bending member 30 is supported by the driving mechanism 40 at both ends thereof in the longitudinal direction as described above is not limited to the structure in which the driving mechanism 40 is fixed to the warp bending member 30 at both ends of the warp bending member 30. When the warp bending member 30 has a high rigidity and is not inclined at the position where the warp bending member 30 is supported by the driving mechanism 40, the warp bending member 30 may be fixed to the driving mechanism 40 at only one end thereof and be guided by a guide member at the other end thereof.

[0056] (3) With regard to the movement of the warp bending member 30, in the above-described embodiment, the warp bending member 30 is in contact with the lower warp yarn row and bends the lower warp yarn row over the entire period in which the main shaft rotates one revolution. However, the structure for moving the warp bending member 30 in the vertical direction is not limited as long as the warp bending member 30 is in contact with and bends the one of the upper and lower warp yarn rows 1 at least at the beating time. For example, in the structure of the above-described embodiment, the amount by which the warp bending member 30 swings may be increased so that the warp bending member 30 becomes separated from the one of the upper and lower warp yarn rows in a period including the time at which the warp bending member 30 reaches the lowermost position.

[0057] At the time when the warp bending member 30 reaches the uppermost position or in a period including that time, the warp bending member 30 may be in contact with both the upper and lower warp yarn rows 1 and bend both the upper and lower warp yarn rows 1 instead of being in contact with only the one of the upper and lower warp yarn rows 1 and bending only the one of the upper and lower warp yarn rows 1. Also in this case, the warp bending member 30 is arranged with respect to the paths of the upper and lower warp yarn rows 1 such that the tension applied to the one of the upper and lower warp yarn rows 1 is higher than that applied to the other one of the upper and lower warp yarn rows 1 and a tension difference is provided between the upper and lower warp yarn rows 1.

[0058] Furthermore, in the above-described embodiment, the warp bending member 30 is moved in the vertical direction in a driving mode such that the warp bending member 30 is at the uppermost position (the amount

by which the lower warp yarn row 1 is bent is at a maximum) at the beating time (when the crank angle is 0°). However, the driving mode in which the warp bending member 30 is moved in the vertical direction is not limited to this, and is not particularly limited as long as the upper or lower warp yarn row can be bent (a tension difference can be provided between the upper and lower warp yarn rows 1) so that the desired picking performance can be obtained at the beating time. The inventors of the present invention conducted experiments in which the picking performance was observed for each of the cases in which the crank angle at which the bending amount reached a maximum was 330°, 345°, 0°, and 30° in the structure of the above-described embodiment. As a result, highest picking performance was obtained in the case of the above-described embodiment (case in which the bending amount of the lower warp yarn row was at a maximum when the crank angle was 0°). However, also in the cases in which the bending amount was at a maximum at crank angles other than 0°, the weft picking performance was high enough to prevent the problems with the quality of the woven cloth.

[0059] In the above-described embodiment, the uppermost position of the warp bending member 30 is such that the upper edge of the warp bending member 30 is above the warp line W. However, the uppermost position of the warp bending member 30 is not limited as long as the tension difference between the upper and lower warp yarn rows 1 at the beating time is such that the desired picking performance can be obtained. More specifically, as described above, the weft picking performance is affected by the tension difference between the upper and lower warp yarn rows 1 at the beating time. However, the tension difference is not determined only by the tension applied to the one of the upper and lower warp yarn rows 1 that is bent by the warp bending member 30, but is determined also by the tension applied to the one of the upper and lower warp yarn rows 1. In addition, assuming that the displacement and set tension for the one of the upper and lower warp yarn rows 1 at the time when the warp yarns 1 are in the shed open state are constant, the tension applied to the one of the upper and lower warp yarn rows 1 is determined by the amount by which the one of the upper and lower warp yarn rows 1 is bent by the warp bending member 30. The bending amount corresponds to the uppermost position of the warp bending member 30. Therefore, the uppermost position of the warp bending member 30 is not limited as long as it is determined in consideration of the above-described conditions. In this case, the present invention is not limited to the structure in which the upper edge of the warp bending member 30 is above the warp line W as in the above-described embodiment.

[0060] (4) With regard to the structure of the warp bending device, in the above-described embodiment, the warp bending device 20 includes the driving mechanism 40 that reciprocates the warp bending member 30 in the vertical direction, and the warp bending member 30 is

moved in the vertical direction in accordance with the shedding motion of the warp yarns. However, the warp bending device according to the present invention is not limited to those including the driving mechanism 40, and may instead be structured such that the warp bending member 30 is fixed in the vertical direction at a position where the one of the upper and lower warp yarn rows 1 is bent by the warp bending member 30 at the beating time. In other words, the warp bending member 30 may be fixed in the vertical direction at a position where it bends the one of the upper and lower warp yarn rows 1 such that the desired tension difference is provided between the upper and lower warp yarn rows 1 at the beating time, as long as the weaving conditions (e.g., set tension), the type of the warp yarns 1, etc., are such that the warp yarns 1 do not receive an excessive tension at the maximum displacement position or no problems occur even when an excessive tension is applied.

[0061] In addition, the warp bending member 30 is not limited to a plate-shaped member as in the above-described embodiment, and may instead be a rod-shaped (columnar) member having a circular or elliptical shape in cross section along a plane perpendicular to the longitudinal direction. Alternatively, the warp bending member 30 may be a prism-shaped member having a rectangular shape in cross section along the plane. In this case, a corner portion that comes into contact with the warp yarns 1 need to be rounded.

[0062] In addition, the warp bending member 30 is not limited to a member in which the upper edge that is in contact with the warp yarns 1 extends along a straight line at a constant vertical position over the entire length thereof in the longitudinal direction. The warp bending member 30 may instead be shaped such that at least the vertical position of both ends of the upper edge in the longitudinal direction differs from that of the central portion of the upper edge in the longitudinal direction, and is shifted toward the row of the warp yarns in the vertical direction. More specifically, in the case where the warp bending member 30 is below the row of the warp yarns, the vertical position of both ends of the upper edge may be above the vertical position of the central portion of the upper edge. In the case where the warp bending member 30 is above the row of the warp yarns, the vertical position of both ends of the upper edge may be below the vertical position of the central portion of the upper edge. This will be described in more detail.

[0063] In general, in a row of warp yarns, the tension applied to the warp yarns at both ends in the weaving-width direction (regions where the selvages of the woven cloth are formed) tends to be lower than that applied to the warp yarns in a central region. In addition, since the warp bending member 30 included in the warp bending device according to the present invention is a long member that extends in the longitudinal direction, there is a possibility that the warp bending member 30 will be deflected due to the tension of the warp yarns. In such a case, the vertical position of both ends of the upper edge

will be lower than that of the central portion of the upper edge in front view. As a result, in the state in which the warp yarns 1 are bent by the warp bending member 30, the amount by which the warp yarns 1 are bent at both ends of the row of the warp yarns 1 in the weaving-width direction will be smaller than that in the central region. Therefore, in the case where the warp bending member 30 is deflected as described above, even when the warp yarns 1 are bent by the warp bending member 30, due to the deflection of the warp bending member 30 and the above-described tendency, a large difference in tension is generated between the warp yarns 1 at both ends and the warp yarns 1 in the central region of the row of the warp yarns 1. As a result, there is a risk that the quality of the woven cloth will be degraded. In addition, when the tension cannot be sufficiently increased, there is a risk that the warp yarns 1 at both ends will cause a shedding failure and a weft insertion failure will occur.

[0064] Accordingly, in consideration of the above-described deflection and other factors, the warp bending member 30 may be curved, for example, such that at least the vertical position of both ends of the upper edge thereof is shifted toward the row of the warp yarns from the vertical position of the central portion of the upper edge. Alternatively, the warp bending member 30 may have a stepped shape such that only the vertical position of both ends of the upper edge thereof is shifted toward the row of the warp yarns from the vertical position of other portions.

[0065] (5) With regard to the loom to which the present invention is applied, according to the above-described embodiment, it is assumed that the heald frames are driven (the shedding motion of the warp yarns is performed) in accordance with the shedding curves (shedding patterns) illustrated in Fig. 2. However, the shedding curves based on which the shedding motion of the warp yarns is performed in the loom to which the present invention is applied are not limited to those illustrated in Fig. 2. The shedding curves are not limited as long as the time at which the warp yarns are set to the shed open state and the time at which the weft yarn is beaten against the cloth fell (beating time) differ from each other. Therefore, the time at which the warp yarns are set to the shed closed state may be later than the beating time.

[0066] In addition, in the above-described embodiment, it is assumed that the warp line W extends horizontally. However, the loom to which the present invention is applied is not limited to this, and the warp line W may instead be inclined. In the case where the warp line W is inclined, it is assumed that a tension difference is provided between the upper and lower warp yarn rows due to the difference between the paths of the upper and lower warp yarn rows. More specifically, in a loom in which the warp line W is inclined such that the height thereof decreases from the tension-roller side toward the cloth-fell side, when the warp yarns are in the shed open state, the tension applied to the lower warp yarn row is higher than that applied to the upper warp yarn row.

Therefore, in such a loom, when the lower warp yarn row is bent by the warp bending member, the tension difference between the upper and lower warp yarn rows can be increased. Alternatively, the tension difference between the upper and lower warp yarn rows can be set to a value similar to that in the above-described embodiment while reducing the amount by which the one of the upper and lower warp yarn rows are bent by the warp bending member.

[0067] The present invention is not limited to the above-described embodiment and modifications, and various changes are possible within the scope of the present invention.

by the warp bending member (30) at a time when the one of the upper and lower warp yarn rows is at the maximum displacement position is smaller than or equal to a degree of bending by the warp bending member (30) at the beating time.

Claims

1. A warp bending device (20) for a loom that includes a dropper-type warp breakage detection device (6) disposed on a warp-let-off side of heald frames and which is set such that a time at which warp yarns (1), which are caused to perform a shedding motion by the heald frames, are set to a shed closed state differs from a beating time at which a weft yarn is beaten against a cloth fell by a reed, the warp bending device (20) comprising:

a warp bending member (30) that is disposed between the dropper-type warp breakage detection device (6) and the heald frames in a warp direction and above or below a row of the warp yarns (1) in a vertical direction and that extends over a region of the row of the warp yarns (1) in a weaving-width direction, the warp bending member (30) being positioned such that the warp bending member (30) is in contact with one of an upper warp yarn row and a lower warp yarn row of the warp yarns (1) that are in a shed open state and bends a path of the one of the upper and lower warp yarn rows at least at the beating time.

2. The warp bending device (20) according to Claim 1, further comprising:

a driving mechanism (40) that reciprocates the warp bending member (30) in the vertical direction and that, when the one of the upper and lower warp yarn rows moves toward a maximum displacement position during the shedding motion after the beating time, drives the warp bending member (30) so that the warp bending member (30) moves in a direction of movement of the one of the upper and lower warp yarn rows.

3. The warp bending device (20) according to Claim 2, wherein the driving mechanism (40) drives the warp bending member (30) so that a degree of bending

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FIG. 1

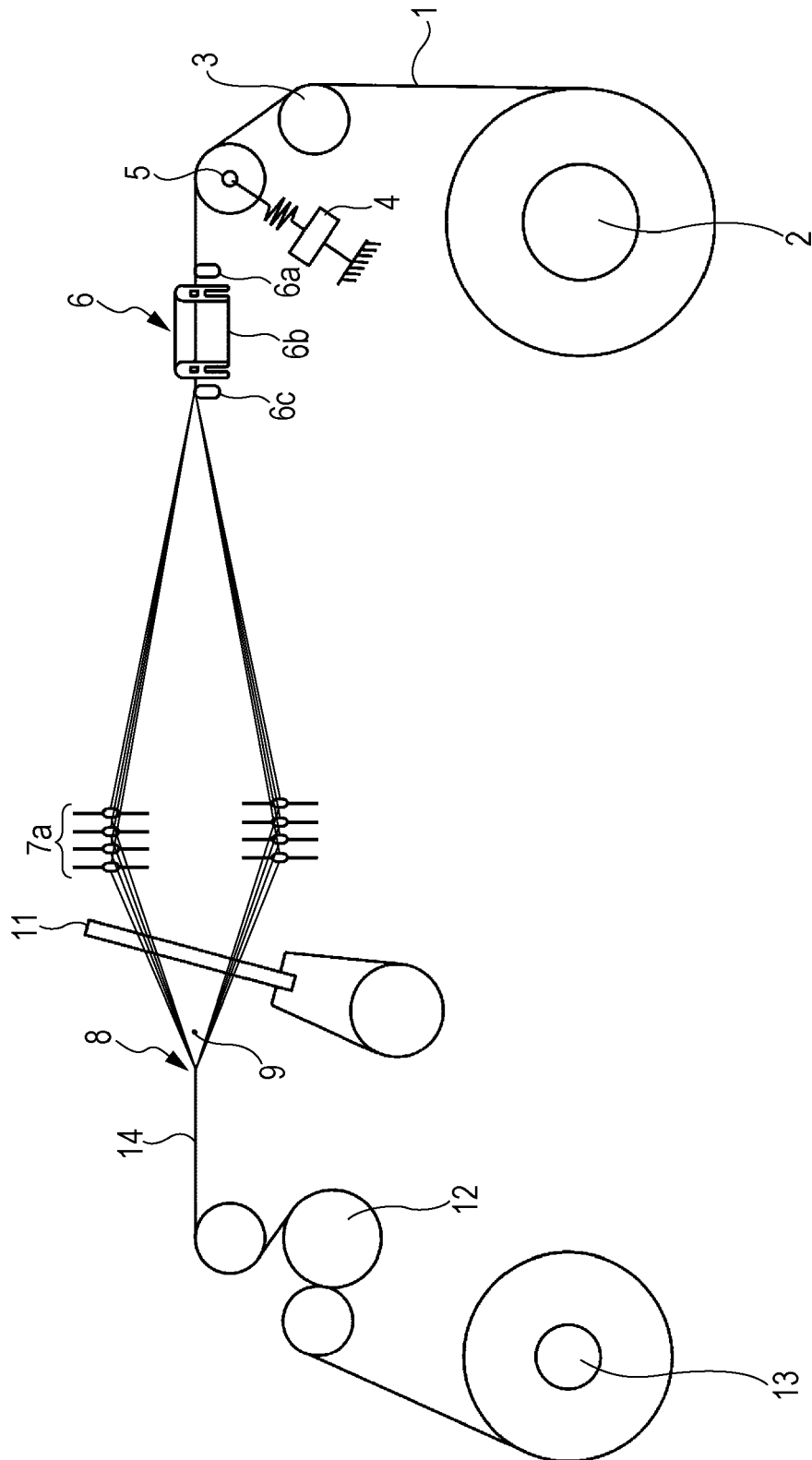


FIG. 2

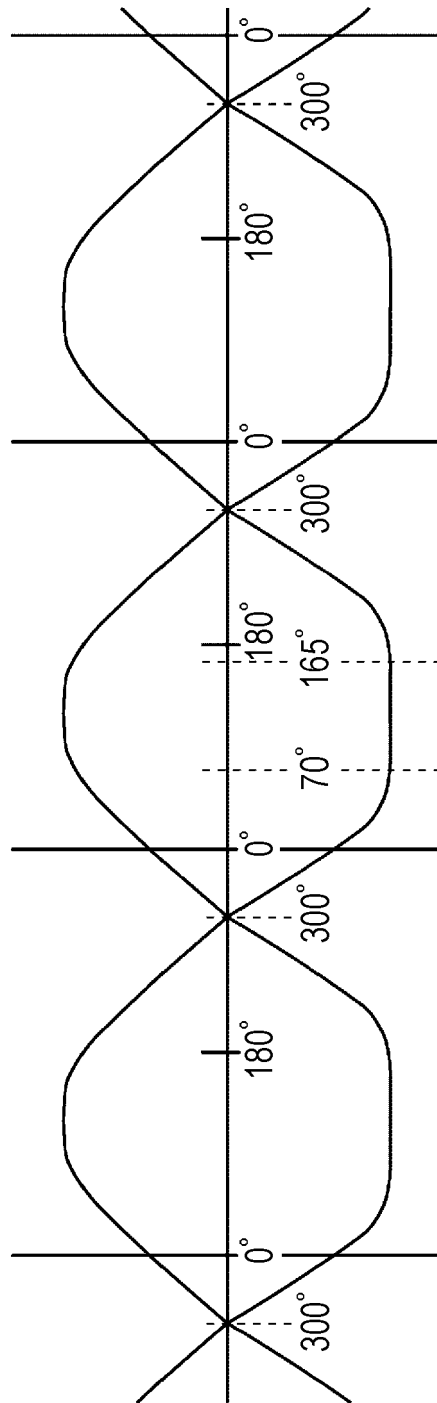


FIG. 3

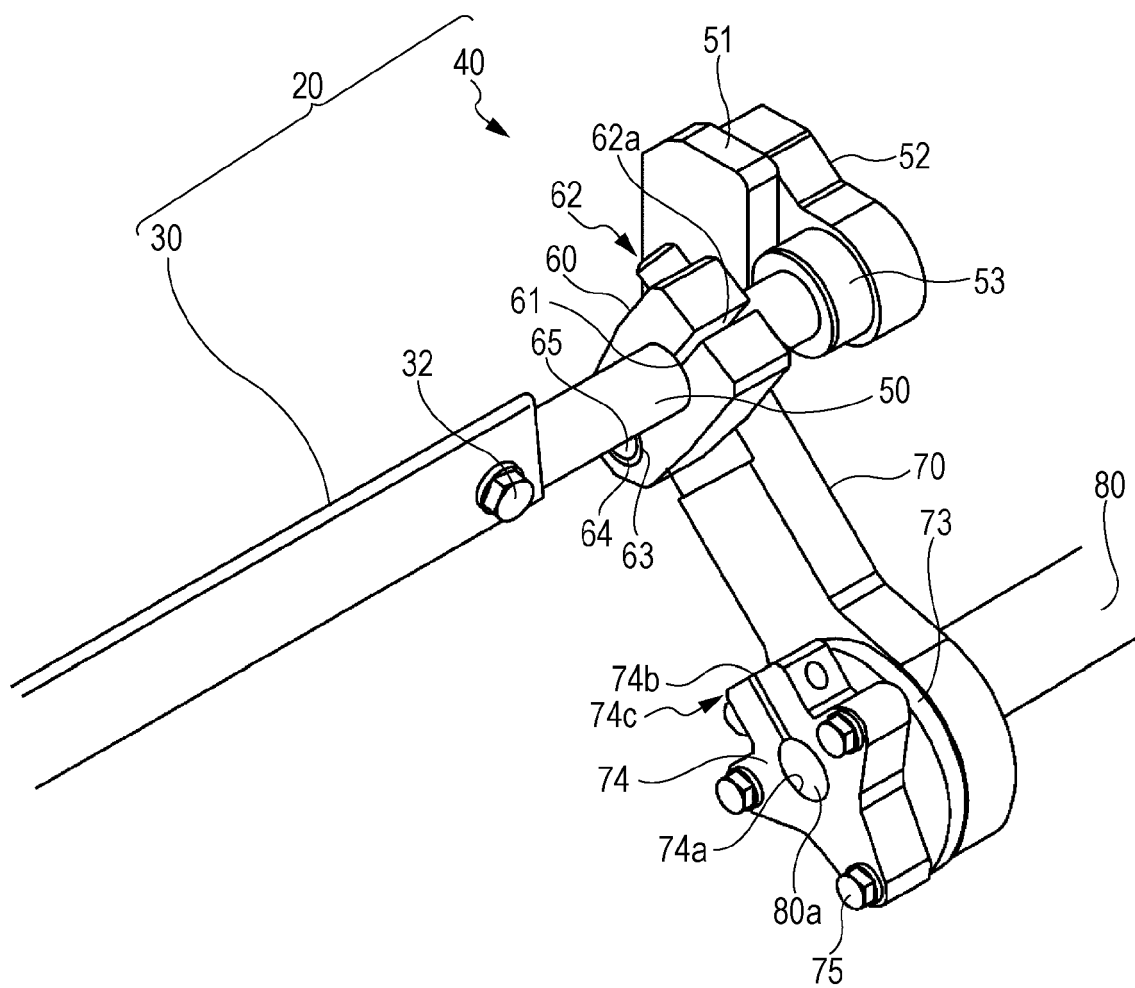


FIG. 4

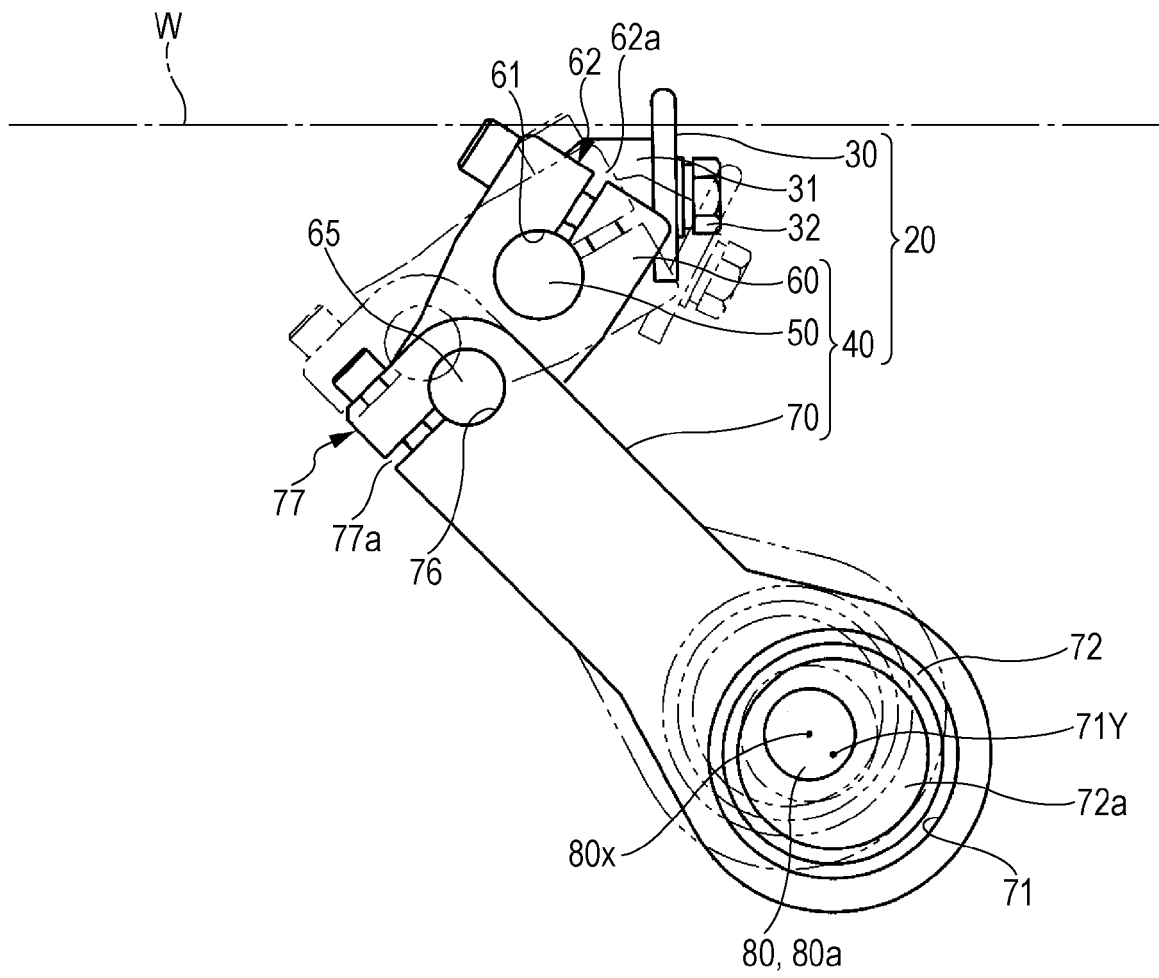


FIG. 5

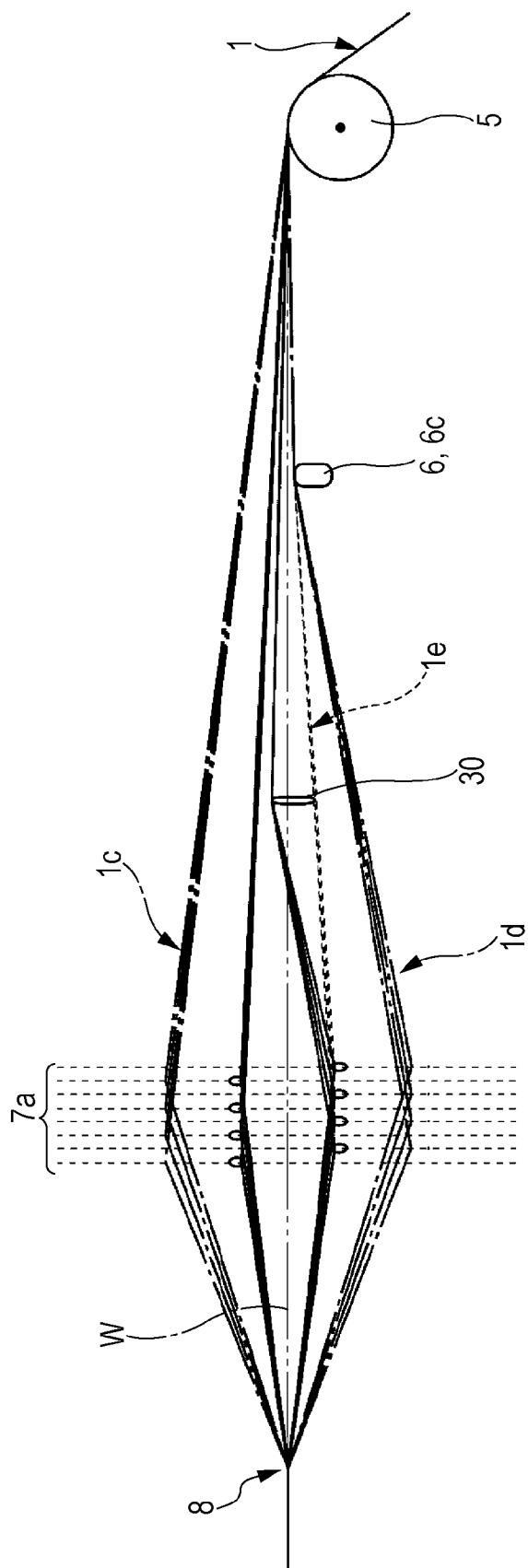
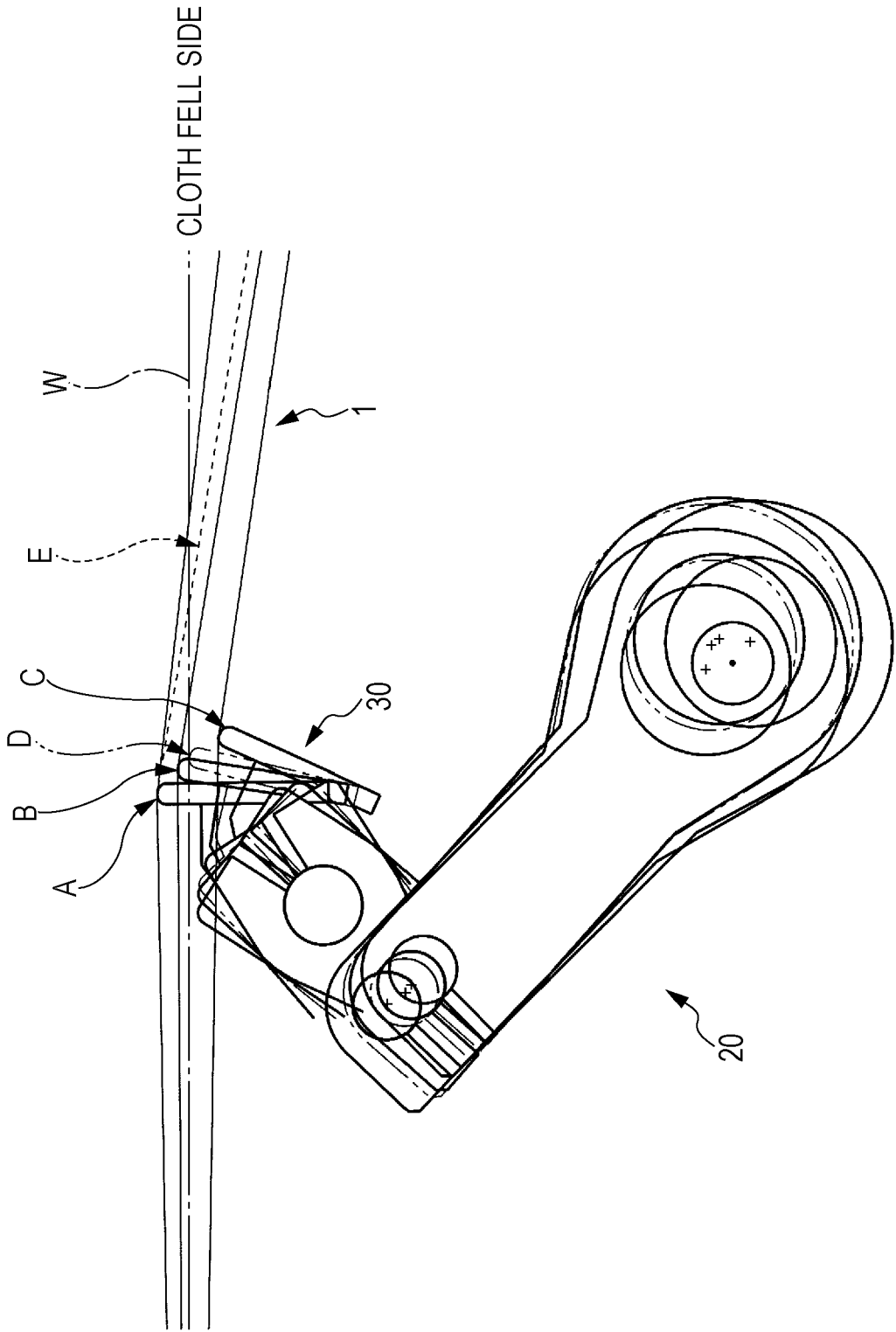


FIG. 6





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Application Number
EP 15 15 2357

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