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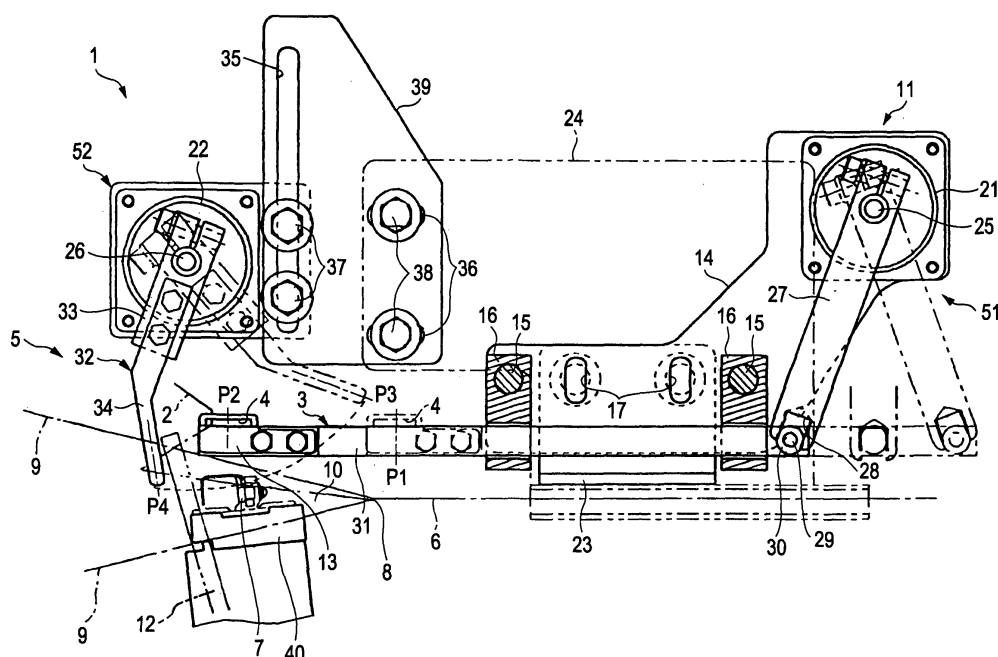
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(54) **Weft insertion method and weft insertion device of rapier loom**

(57) In a weft insertion device (1) of a rapier loom, to insert a weft (2) through a guide hole (4) at a tip end part of a weft guide lever (3) and to guide the weft (2) connected to a woven fabric (6) to a catchable position of a rapier head (7), the weft guide lever can reciprocate between first and second positions (P1: retreat position, P2: guide position).. The guide hole is located at the second

position at start of weft insertion so that the rapier head catches the weft. Then, before beating up, the weft guide lever is driven to move the guide hole toward the first position, thereby markedly reducing bending of the warp and sliding thereof on a reed (12) etc. because of a positional relationship between the weft guide lever and the reed and preventing the weft from being damaged because of bending and sliding.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a weft insertion method and a weft insertion device for preventing a weft from being damaged in a weft insertion process of a rapier loom.

2. Description of the Related Art

[0002] In a rapier loom, a weft to be inserted next is guided to a position (hereinafter, also referred to as "catchable position") at which a rapier head (insert rapier) can catch the weft. At this time, the weft connected to a selvage of a woven fabric at a weft-supply side intersects with a running path of the rapier head at the catchable position. Then, the rapier head catches the weft at the catchable position when the rapier head is advanced for weft insertion, carries the weft into a shed of warps, and thus performs the weft insertion. After the weft insertion is completed, a reed starts its advancement (beating-up motion) toward a cloth fell, and the inserted weft is beaten up by the reed to the cloth fell.

[0003] Japanese Unexamined Patent Application Publication No. 9-217248 discloses a rapier loom including a selection device which inserts a weft selectively supplied from one of at least two weft-supply members. The selection device includes at least two selection bars as weft guide members to guide the weft let off from the corresponding weft-supply member to a catchable position of a rapier head. Each selection bar has a guide hole at a tip end part of the selection bar. A weft is inserted through the guide hole. While the weft is held in the guide hole, the selection bar is driven by a rotary solenoid to be advanced and retracted between two positions including a selection position, at which the weft is guided to the rapier head at the catchable position of the rapier head, and a retreat position, at which the weft is held at a position that the rapier head cannot catch the weft.

[0004] In a typical rapier loom, a guide hole through which a weft is inserted is constant in a warp direction. In the case of the technique disclosed in Japanese Unexamined Patent Application Publication No. 9-217248, the selection bars are advanced and retracted substantially vertically (in up-down direction). Hence, the position of the guide hole is substantially constant in a substantially horizontal warp direction. To allow the rapier head to catch the weft, the guide hole has to guide the weft at a side farther from a cloth fell than a running path of the rapier head (i.e., closer to a let-off side of the warp than the cloth fell). In the state where the weft is catchable, the weft is let off from the weft-supply member, extends across the running path of the rapier head through the guide hole of the selection bar, and is connected to the cloth fell of a woven fabric.

[0005] With the rapier loom of the above-described configuration, the following problem may occur. Since the guide hole guides the weft at the position farther from the cloth fell than the running path of the rapier head, the weft is guided in a bending manner toward the cloth fell at the position of the guide hole. Also, the weft located within the shed of the warps engages with (contacts) a weft-supply side end part of the reed, and bends toward the position far from the cloth fell at the engagement position. After the weft insertion, the weft in the shed of the warps is carried toward the cloth fell by the beating-up motion of the reed. As the reed moves closer to the cloth fell, bending degrees of the weft at the two positions (the position of the guide hole, the position of the weft-supply side end part of the reed) increase.

[0006] Consequently, the weft contacts an inner peripheral surface of the guide hole and the weft-supply side end part of the reed and slides thereon while the weft receives large resistances because of bending at the two bending positions. Therefore, the weft may be damaged, resulting in the weft being fluffed. In some cases yarn breakage may occur. The weft located close to the guide hole may remain in the shed of the warps at the next weft insertion. Hence, if the weft at that part is fluffed, the quality of a woven fabric may be degraded. If the yarn breakage occurs, the weft cannot be used for a next weft insertion. The loom has to be stopped and recovered.

[0007] Also, when a flat yarn such as a yarn made of carbon fiber is used as a weft, the flat weft may be pressed in a width direction and deformed by being bent at the end part of the reed, and the deformation may affect the part of the weft located within the shed of the warps. Hence, the part of the weft close to the selvage at the weft-supply side may have a smaller width than the other part. Consequently, the woven fabric to be produced may be defective in quality.

SUMMARY OF THE INVENTION

[0008] Accordingly, an object of the present invention is, in a rapier loom, to markedly reduce bending of a weft or sliding of the weft on a reed etc. occurring because of a positional relationship between the reed and a weft guide member which causes a selected weft to be arranged at a position, at which a rapier head can catch the weft, and prevent the weft from being damaged because of bending and sliding.

[0009] In light of the situations, the present invention provides a weft insertion device. In a rapier loom including the weft insertion device, to insert a weft through a guide hole at a tip end part of a weft guide lever (weft guide member) and guide the weft connected to a woven fabric to a catchable position at which a rapier head can catch the weft, the weft guide lever can reciprocate between a first position and a second position, the first position being a retreat position closer to a cloth fell, the second position being a guide position closer to a running path of the

rapier head. Before weft insertion, the guide hole of the weft guide lever is moved toward the second position, so that the weft is guided at the catchable position of the rapier head. Before the rapier head performs beating up after the rapier head catches the weft, the weft guide lever is driven in a direction of an advancement motion of a reed to move the guide hole toward the first position, so that bending of the warp and sliding of the warp on the reed etc. occurring because of a positional relationship between the weft guide lever and the reed, are markedly reduced, and the weft is prevented from being damaged because of bending and sliding of the weft. Herein, the expression "beating up" does not represent an advancement motion of the reed toward the cloth fell, but represents a motion of beating up a weft to the cloth fell. In contrast, the expression "beating-up motion" represents the advancement motion of the reed to carry the weft to the cloth fell.

[0010] In particular, a weft insertion method of a rapier loom according to an aspect of the present invention is provided. The rapier loom includes a weft insertion device. The weft insertion device includes a weft guide mechanism. The weft guide mechanism includes a weft guide lever having a guide hole at a tip end part of the weft guide lever, a weft being inserted through the guide hole. The weft guide mechanism guides the weft connected to a woven fabric to a catchable position, at which a rapier head is capable of catching the weft. The weft guide mechanism is capable of causing the weft guide lever to reciprocate to selectively locate the guide hole between a first position and a second position, the first position being a retreat position closer to a cloth fell than a running path of the rapier head in a warp direction, the second position being a position farther from the cloth fell than the first position in the warp direction, the second position being also a guide position closer to the running path of the rapier head than the cloth fell. The method includes the step of driving the weft guide lever to move such that the guide hole, which is arranged at the second position at start of weft insertion, moves toward the first position before a reed performs beating up.

[0011] Also, a weft insertion device of a rapier loom according to another aspect of the invention is provided. The weft insertion device includes a weft guide mechanism. The weft guide mechanism includes a weft guide lever having a guide hole at a tip end part of the weft guide lever, a weft being inserted through the guide hole; and a drive mechanism driving the weft guide lever. The weft guide mechanism guides the weft connected to a woven fabric to a catchable position at which a rapier head is capable of catching the weft. The drive mechanism causes the weft guide lever to reciprocate to selectively locate the guide hole between a first position and a second position, the first position being a retreat position closer to a cloth fell than a running path of the rapier head in a warp direction, the second position being a position farther from the cloth fell than the first position in the warp direction, the second position being also a

guide position closer to the running path of the rapier head than the cloth fell, the drive mechanism also driving the weft guide lever such that the guide hole arranged at the second position starts moving toward the first position before a reed performs beating up.

[0012] In the weft insertion method and the weft insertion device of the rapier loom, the operation mode of the weft guide lever may be determined such that a relative positional relationship between the reed and the guide hole is within a weaving allowable range. In this case, in the weft insertion device, the drive mechanism drives the weft guide lever with the operation mode.

[0013] Herein, "the operation mode of the weft guide lever" is a start timing and/or a movement speed at which the weft guide lever starts the movement to move the guide hole from the second position toward the first position.

[0014] Also, "the weaving allowable range of the relative positional relationship" is an allowable range relating to weaving in view of the relative positional relationship between the reed and the guide hole in the warp direction. The range of the relative positional relationship between both components allows a woven cloth with a desired quality to be woven. The details will be given below.

[0015] In a loom, an operation timing of the reed is basically constant. Hence, the relative positional relationship between the reed and the guide hole varies depending on the operation mode of the weft guide lever. Also, the relationship between a weft insertion period and a beating-up motion is constant. Hence, the above-mentioned relative positional relationship can represent the relationship between the weft insertion period and the position of the guide hole. Depending on the position of the guide hole in relation to the reed and the weft insertion period, the weft and warp may be damaged and the quality of a woven cloth to be produced may be affected. For example, example cases will be described as follows.

(1) In a case where the movement of the weft guide lever is started at a timing earlier than the beating-up motion of the reed which is started after the weft insertion is completed, when the movement start timing is too early, i.e., when the movement of the weft guide lever is started at an early timing during the weft insertion period, a relative distance between the reed and the guide hole becomes large, and the distance becomes the maximum when the guide hole reaches the first position before the beating-up motion is started. When the relative distance between the reed and the guide hole becomes large, a weft-supply-side part of the weft to be guided to the guide hole approaches the cloth fell at an earlier timing (during weft insertion period). When the weft reaches an area close to the cloth fell during the weft insertion period, the weft slides in the weft insertion direction with respect to the warps at the weft-supply side by the weft insertion because an amount of shed of the warps is small in the area close to the cloth fell. Con-

sequently, weaves (in particular, warps) may be damaged, and the quality of a woven cloth to be produced may be degraded.

(2) In contrast, in a case where the movement of the weft guide lever is started at a timing later than the start of the beating-up motion, in particular, in a case where the movement of the weft guide lever is started after the reed passes the position of the guide hole in the warp direction, the inserted weft bends at a weft-supply side end part of the reed. When the bending amount increases, i.e., when the relative distance between the reed and the guide hole increases, the weft may be damaged because of bending and sliding at the weft-supply side end part of the reed, and the quality of a woven cloth to be produced may be degraded, in a similar manner to the above-mentioned related art.

[0016] However, in some cases, sliding between the weft and the warp in the weft insertion direction, i.e., setting the operation mode of the weft guide lever such that the relative distance between the reed and the guide hole causes sliding, may be allowable. Depending on the types of wefts and warps, or depending on the desired quality of a woven cloth, sliding with a certain degree may be allowable, or sliding may not affect the quality of the woven cloth. Also, in some cases, bending of the weft at the weft-supply side end part of the reed at the as a result of the increase in the relative distance between the guide hole and the reed while the guide hole is farther from the cloth fell than the reed, may be allowable with a certain degree in view of the quality of the woven cloth. Hence, regarding the relative positional relationship between the guide hole and the reed, the relationship which is variable in relation to the beating-up motion of the reed, the effect of the relative positional relationship to the quality of a woven cloth may be taken into account, and the operation mode of the weft guide lever may be determined such that the relative positional relationship falls within a range in which the level of effect satisfies the desired quality of the woven cloth. This range is the above-described weaving allowable range. It is to be noted that the relative positional relationship between the reed and the guide hole corresponds to not only the distance (relative distance) between the reed and the guide hole, but also a timing at which the reed and the guide hole have a certain positional relationship.

[0017] In the weft insertion method and the weft insertion device of the rapier loom, the movement of the weft guide lever toward the first position may be started when the rapier head is exited from a shed of warps or later, before beating up of the rapier head is performed. In this case, in the weft insertion device, the drive mechanism may start driving the weft guide lever in a period from when the rapier head is exited from the shed of the warps or later until beating up of the reed is performed.

[0018] In the weft insertion method and the weft insertion device of the rapier loom, the weft insertion mecha-

nism may further include a second guide lever in addition to the weft guide lever, which serves as a first guide lever, the second guide lever being farther from the cloth fell than the first guide lever and guiding the weft to the catchable position of the rapier head in cooperation with the first guide lever. The second guide lever may be driven to reciprocate between a third position as a retreat position and a fourth position as a guide position at the start of the weft insertion. In this case, in the weft insertion device, the weft insertion mechanism may include a second drive mechanism for driving the second guide lever between the third and fourth positions, in addition to the drive mechanism, which serves as a first drive mechanism for driving the first guide lever between the first and second positions.

[0019] Further, in the weft insertion method and the weft insertion device of the rapier loom, the second guide lever, which guides the weft at the fourth position at the start of the weft insertion, is moved toward the third position as the retreat position when the rapier head catches the weft or later. In this case, in the weft insertion device, the second drive mechanism may perform the movement of the second guide lever.

[0020] The aspects of the present invention mainly use multi-color weft insertion; however, the present invention can be applied to weft insertion of a single color. In the case of multi-color weft insertion, the weft guide mechanism guides selected one of a plurality of wefts to the catchable position (second position).

[0021] With the weft insertion method and the weft insertion device of the rapier loom according to the aspects of the present invention, the weft guide mechanism is used. The weft guide mechanism drives the weft guide lever, the guide hole of which is located at the second position at the start of the weft insertion, to move the guide hole toward the first position before the reed performs beating up. In other words, the weft guide mechanism is configured such that the guide hole arranged at the second position at the start of the weft insertion is moved toward the first position in the warp direction by the movement operation of the guide lever. Accordingly, an angle defined by the weft located between the warp array and the weft guide lever and the weft in the shed of the warps in the warp direction during the beating-up motion of the reed can be decreased as compared with related art. Consequently, bending of the weft at the weft-supply side end part and at the guide hole can be decreased. The weft can be prevented from being damaged because of sliding of the weft on the weft-supply side end part of the reed and the guide hole.

[0022] When the operation mode of the weft guide lever is determined such that the relative positional relationship between the reed and the guide hole in the warp direction is within the weaving allowable range, the weft and warp would not be markedly damaged because of bending of the weft and sliding of the weft and warp in the weft insertion direction. Hence, a defectively woven part does not appear. Thus, within the weaving allowable

range, the operation mode of the weft guide lever, in particular, the timing, the speed, the acceleration, etc., when the guide hole is displaced from the second position to the first position are more freely determined.

[0023] The movement of the weft guide lever may be started when the rapier head is exited from the shed of the warps or later, that is, when the weft insertion into the shed of the warps is almost completed or later. Accordingly, after the reed starts the beating-up operation, the weft in the shed of the warps engages with the reed in a manner substantially parallel to the reed. Hence, picking of the weft to the cloth fell is stably performed.

[0024] The operation to arrange the weft to the catchable position may be performed by cooperation of the first guide lever (weft guide lever) and the second guide lever. Accordingly, loads of the drive mechanisms for driving the levers can be decreased, and the weft insertion can be stably performed. In particular, in a case where the first position is close to the cloth fell to markedly decrease bending of the weft, when the guide hole is moved from the first position to the catchable position, the movement amount of the weft guide lever (first guide lever) is increased, and the load applied to the driving mechanism is increased. In particular, when the drive mechanism drives the weft guide lever by using a dedicated rotation drive source, it becomes difficult to follow a target operation as the speed of the loom is increased. Thus, insertion error may occur, and the error may interrupt an increase in speed of the loom.

[0025] In contrast, since the weft guide mechanism is arranged to cause the weft to be arranged at the catchable position by cooperation of the two guide levers, that is, since the movement amount of the first guide lever is decreased and the second guide lever handles the residual movement of the weft to the catchable position, the loads applied to the drive mechanisms of the guide levers are decreased. Even when the loom is operated at a high speed, weft insertion can be stably performed.

[0026] By moving the second guide lever, which guides the weft at the fourth position at start of the weft insertion, toward the third position (standby position) when the rapier head catches the weft or later, the weft can be prevented from rubbing on the weft-supply side end part of the reed during the weft insertion. In particular, to allow the rapier head to catch the weft, the weft has to be guided to intersect with the running path of the rapier head. Hence, the second guide lever, which guides the weft at the catchable position, may guide the weft at the position farther from the cloth fell than the running position of the rapier head during the weft insertion. Typically, the running path of the rapier head is arranged at a position close to the reed in the warp direction. Accordingly, the guide position of the second guide lever is located at the position farther from the cloth fell than the front surface of the reed. The weft is hence let off while rubbing on the weft-supply side end part of the reed during the weft insertion. Consequently, the weft may be fluffed, and the quality of the woven fabric to be produced may be de-

graded. In addition, when the weft is the flat yarn as described above, the yarn may be twisted, resulting in a defective of the woven fabric.

[0027] In contrast, the second guide lever, which guides the weft at the position farther from the cloth fell than the running path of the rapier head at the start of the weft insertion, may be moved to be restored to the standby position when the rapier head catches the weft or later. Accordingly, the guide position of the weft can be a position closer to the cloth fell than the front surface of the reed. Thus, rubbing between the weft-supply side end part and the weft can be prevented during the weft insertion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

Fig. 1 is a side view showing a weft insertion device of a rapier loom according to an embodiment of the present invention;

Fig. 2 is a plan view showing the weft insertion device of the rapier loom according to the embodiment;

Figs. 3A and 3B are displacement diagrams respectively showing first and second guide levers in the weft insertion device of the rapier loom according to the embodiment;

Figs. 4A to 4E are explanatory views showing an operation of the weft insertion device of the rapier loom according to the embodiment;

Figs. 5A and 5B are explanatory views showing a weft guide mechanism in a weft insertion device of two colors;

Fig. 6 is an explanatory view showing a weft guide mechanism in a weft insertion device of three colors;

Fig. 7 is an explanatory view showing part of a weft guide mechanism with a link mechanism; and

Fig. 8 is an explanatory view showing a primary portion of a weft guide mechanism with a rotational movement.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] Figs. 1 to 4 illustrate a weft insertion device 1 of a rapier loom according to an embodiment of the present invention. Herein, the rapier loom is a both-side rapier loom, in which, for example, a rapier head 7 for insertion is advanced from a weft-supply side, and a rapier head 71 for carriage is advanced from a non-weft-supply side into a shed 10 of warps 9. At an intermediate point in the shed 10, a weft 2 is transferred from the rapier head 7 to the rapier head 71 to perform weft insertion. The illustrated weft insertion device 1 of the rapier loom is an example for weft insertion of a single color, in which a single weft-supply member supplies a weft 2 and the rapier heads 7 and 71 insert the weft 2. The weft 2 is, for example, a flat yarn.

[0030] Referring to Figs. 1 and 2, the weft insertion

device 1 includes a weft guide mechanism 5 and a drive mechanism 11. During weft insertion, the weft guide mechanism 5 guides the weft 2 connected to a salvage of a woven fabric 6 toward a catchable position of the rapier head 7. The drive mechanism 11 drives the weft guide mechanism 5. The weft guide mechanism 5 includes a first guide lever 31 and a second guide lever 32. The first guide lever 31 is a weft guide lever 3 having a guide hole 4 at a tip end part of the weft guide lever 3. The weft 2 is inserted through the guide hole 4. The second guide lever 32 guides the weft 2 to the catchable position of the rapier head 7 in cooperation with the first guide lever 31.

[0031] The first guide lever 31 can linearly reciprocate in a warp direction, and is driven by a first drive mechanism 51 which is the drive mechanism 11. The first drive mechanism 51 includes a first drive motor 21 and a rotatable lever 27. The first drive mechanism 51 transmits reciprocative rotation of an output shaft 25 of the first drive motor 21 to the first guide lever 31 through the rotatable lever 27.

[0032] The first drive mechanism 51 drives the first guide lever 31 to selectively locate the guide hole 4 between a first position P1 and a second position P2. The first position P1 is a retreat position closer to a cloth fell 8 than a running path of the rapier head 7 in the warp direction. The second position P2 is a position farther from the cloth fell 8 than the first position P1 in the warp direction and serves as a guide position closer to the running path of the rapier head 7 than the cloth fell 8. In the illustrated embodiment, the first position P1 is determined such that an end part of the guide hole 4 close to a reed 12 is located close to the cloth fell 8 in the warp direction, and the second position P2 is determined such that an intermediate part of the guide hole 4 is located on the running path of the rapier head 7.

[0033] The first drive mechanism 51 drives the first guide lever 31, which is arranged such that the guide hole 4 is located at the second position P2 at start of weft insertion, to start movement of the first guide lever 31 such that the guide hole 4 moves toward the first position P1 before the reed 12 performs beating up. In this embodiment, a drive mode of the first drive mechanism 51 is determined such that the movement of the first guide lever 31 is started after the weft insertion of the weft 2 into the shed 10 of the warps 9 is completed. In particular, the movement of the first guide lever 31 is started after the beating-up motion of the reed 12 is started after the rapier heads 7 and 71 are exited from the shed 10, and when the reed 12 reaches the second position P2 in the warp direction and the reed 12 engages with the inserted weft 2. The first guide lever 31 has a movement speed corresponding to a movement speed of the reed 12. Accordingly, an operation mode of the first guide lever 31, as the weft guide lever 3 of this embodiment, is determined such that the movement is started after the movement of the beating-up motion of the reed 12 is started, and that the first guide lever 31 is moved with the reed

12 in a state where the position of the first guide lever 31 correspond to the position of the reed 12 in the warp direction.

[0034] In the illustrated embodiment, the second guide lever 32 is driven to swing in a reciprocating manner in the warp direction. The second guide lever 32 is driven by a second drive mechanism 52. The second drive mechanism 52 causes swinging movement in a reciprocating manner of the second guide lever 32 by reciprocal rotation of an output shaft 26 of a second drive motor 22. Accordingly, the second guide lever 32 is driven to reciprocate between a third position P3 and a fourth position P4. The third position P3 is a retreat position. The fourth position P4 is a position at the start of the weft insertion and serves as a guide position at which the second guide lever 32 guides the weft 2 at a position farther from the cloth fell 8 than a front surface of the reed 12 in the warp direction. In a swing process from the third position P3 to the fourth position P4, the second guide lever 32 engages with the weft 2 guided to the guide hole 4 of the first guide lever 31 at the second position P2, and guides the weft 2 to the catchable position of the rapier head 7 at the fourth position P4. In the illustrated embodiment, the third position P3 is a position achieved when the second guide lever 32 swings toward the cloth fell 8 from the fourth position P4. At the third position P3, the second guide lever 32 does not engage with the weft 2 which moves toward the cloth fell 8 by the beating-up motion of the reed 12.

[0035] In this embodiment, the second guide lever 32 located at the fourth position P4 at the start of the weft insertion is moved toward the third position P3 as the retreat position when the rapier head 7 catches the weft 2 or later. For this movement, the second drive motor 22 drives the second guide lever 32 to retract the second guide lever 32 from the fourth position P4 toward the third position P3 at a predetermined timing when the rapier head 7 catches the weft 2 or later.

[0036] Referring to Figs. 1 and 2, respective components of the weft insertion device 1 will be described in more detail.

[0037] The first guide lever 31 includes a main body, which is a rod-like member with a circular cross section, and a guide member 13 attached to a tip end of the main body. The guide member 13 guides the weft 2. The guide member 13 is formed of a plate member, and has the rectangular guide hole 4 which guides a flat yarn as the weft 2. Before the weft insertion, the weft 2 let off from a weft-supply member (not shown) is passing through the guide hole 4 at the first position P1 and is being connected to a salvage of the woven fabric 6.

[0038] The first guide lever 31 is supported movably substantially in parallel to a warp line by a guide hole of a guide member 16 which is attached to a first support bracket 14 with an attachment bolt 15. The guide member 16 is attached to a surface of the first support bracket 14 close to the woven fabric 6. Two guide members 16 are provided to guide the first guide lever 31 at two positions

in a sliding manner. The first support bracket 14 is adjustably attached to an L-shaped bracket 23 through a long hole 17 and an adjustment bolt 19. The L-shaped bracket 23 is adjustably attached to a base bracket 24 through a long hole 18 and an adjustment bolt 20. As a result, the first support bracket 14 is attached in an adjustable manner in a height direction and the warp direction.

[0039] The first drive mechanism 51 includes the rotatable lever 27 which couples the output shaft 25 of the first drive motor 21 with the first guide lever 31, an engagement pin 29 attached to the first guide lever 31, and a roller 30 which is rotatably held by the engagement pin 29 and engages with an engagement groove 28 of the rotatable lever 27, in addition to the first drive motor 21 and the guide member 16. The first drive mechanism 51 drives the weft guide lever 3 to reciprocate, by swinging movement of the rotatable lever 27 because of the reciprocative rotation of the output shaft 25 of the first drive motor 21.

[0040] The first drive motor 21 is supported by the first support bracket 14 while the direction of the output shaft 25 is parallel to the weft insertion direction. An end of the rotatable lever 27 is attached and fixed to the output shaft 25 of the first drive motor 21 at a predetermined phase. In the illustrated embodiment, the rotatable lever 27 is fixed to the output shaft 25 of the first drive motor 21 by fixing with a split clamp. The rotatable lever 27 can be fixed to the output shaft 25 at a desirable phase.

[0041] The engagement pin 29 is fixed to a rear end of the first guide lever 31. The engagement pin 29 rotatably holds the spherical roller 30. The roller 30 is formed such that opposite parts of spherical members are chamfered to be flat surfaces. Another end of the rotatable lever 27 is split into two parts such that a pair of coupling legs faces one another. The split parts define the engagement groove 28. The facing surfaces of the engagement groove 28 are arcuate to fit with a spherical surface of the roller 30. With this structure, the first guide lever 31 and the rotatable lever 27 are coupled through the roller 30 in a slidable manner within the engagement groove 28 in a longitudinal direction of the rotatable lever 27. A displacement of the rotatable lever 27 due to swinging thereof at the coupling position between the first guide lever 31 which is movable only linearly in the warp direction and the rotatable lever 27 which is driven to swing, is permitted because the roller 30 slides within the engagement groove 28.

[0042] With the structure, when the rotatable lever 27 is driven by the first drive motor 21 to swing in a reciprocating manner within a range of a predetermined angle, the first guide lever 31 moves in a reciprocating manner between a advanced position at which the guide hole 4 is located at the first position P1 and a retracted position at which the guide hole 4 is located at the second position P2. With the movement, the guide hole 4 is selectively located at one of the first position P1 and the second position P2. Fig. 1 uses a solid line to illustrate a state

where the guide hole 4 is located at the second position P2 (the guide position at the weft insertion) because of the advancement of the first guide lever 31. Also, Fig. 1 uses a two-dot chain line to illustrate a state where the guide hole 4 is located at the first position P1 (retreat position) because of the retraction of the first guide lever 31.

[0043] The second guide lever 32 includes an attachment member 33 which is fixed to the output shaft 26 of the second drive motor 22, and a weft engagement member 34 which is fixed to the attachment member 33. The weft engagement member 34 engages with the weft 2 and guides the weft 2 to the catchable position. The attachment member 33 is fixed to the output shaft 26 of the second drive motor 22 by fixing with a split clamp similarly to the rotatable lever 27. Hence, the second guide lever 32 can be fixed to the output shaft 26 at a desirable phase. Here, the second drive motor 22 and the attachment member 33 define the second drive mechanism 52 which drives the second guide lever 32. That is, the attachment member 33 is a member that defines part of the second guide lever 32 and also part of the second drive mechanism 52.

[0044] The second drive motor 22 is attached to a second support bracket 39 through a long hole 35 and an adjustment bolt 37 such that the position of the second drive motor 22 is adjustable in the up-down direction. The second support bracket 39 is attached to the base bracket 24 through a long hole 36 and an adjustment bolt 38 such that the position of the second support bracket 39 is adjustable in the warp direction. Consequently, the second drive motor 22 is attached such that the position thereof is adjustable in the height direction and the warp direction.

[0045] With the structure, by the reciprocative rotation of the output shaft 26 of the second drive motor 22, the second guide lever 32 is driven to swing in a reciprocating manner between the third position P3 and the fourth position P4. Fig. 1 uses a solid line to illustrate a state where the second guide lever 32 is located at the fourth position P4 (the guide position at which the weft 2 is guided at the catchable position at the start of the weft insertion). Also, Fig. 1 uses a two-dot chain line to illustrate a state where the second guide lever 32 is located at the third position P3 (retreat position). In a process in which the second guide lever 32 is driven by the second drive motor 22 and hence rotates from the third position P3 toward the fourth position P4, the weft 2 connected to the selvage of the woven fabric 6 through the guide hole 4 of the first guide lever 31 at the second position P2 engages with the second guide lever 32 and is carried to the catchable position of the rapier head 7.

[0046] Figs. 3A and 3B, and Figs. 4A to 4E are explanatory views showing an operation and an action of the weft insertion device 1 of the rapier loom shown in Figs. 1 and 2. Fig. 3A is a displacement diagram of the first guide lever 31. Fig. 3B is a displacement diagram of the second guide lever 32. The horizontal axis of both dia-

grams is a rotation angle of a main shaft of the loom (crank angle of the loom). The vertical axis of Fig. 3A is an operation angle (rotation angle) of the rotatable lever 27 which causes the first guide lever 31 to reciprocate, with reference the first position P1 (retreat position). The vertical axis of Fig. 3B is an operation angle (rotation angle) of the second guide lever 32 with reference to the third position P3 (retreat position). Figs. 4A to 4E are explanatory diagrams showing a weft insertion operation. The operation will be described with reference to Figs. 1, 3A, 3B etc. on the basis of the operation order shown in Figs. 4A to 4E.

(1) Prior to the weft insertion, the first guide lever 31 is advanced from the retracted position (position indicated by the two-dot chain line in Fig. 1) which is the retreat position at which the guide hole 4 is located at the first position P1 toward the advanced position (position indicated by the solid line in Fig. 1) which is the position for the weft insertion and at which the guide hole 4 is located at the second position P2 (Fig. 3A: crank angles from 0° to 40°). Then, the first guide lever 31 is stopped at the second position P2 (Fig. 3A: crank angles from 40° to 320°). Accordingly, the weft 2 let off from the weft-supply member is connected to the selvage of the woven fabric 6 through the guide hole 4 of the first guide lever 31 located on the running path (fixing guide 40) of the rapier head 7 of the insert rapier.

Referring to Figs. 1 and 2, the fixing guide 40 is attached to a loom frame (not shown) to define the running path of the rapier head 7. The rapier head 7 is guided along the running path of the fixing guide 40 and reciprocates by a reciprocating drive mechanism (not shown). During the weft insertion, the rapier head 7 is driven by the reciprocating drive mechanism and moves from a back side to a front side of Fig. 1 (from an upper side to a lower side of Fig. 2). (2) After driving of the first guide lever 31 is started, driving of the second guide lever 32 is started. The second guide lever 32 rotates from the third position P3 as the retreat position to the fourth position P4 as the guide position (Fig. 3B: crank angles from 5° to 40°). In the process of rotation, the second guide lever 32 engages with the part of the weft 2 connected to the selvage of the woven fabric 6 through the guide hole 4 of the first guide lever 31, and reaches the fourth position P4. Accordingly, the part of the weft 2 is guided to the catchable position of the rapier head 7 (Fig. 4A).

In the state where the second guide lever 32 can guide the weft 2 at the fourth position P4, the weft 2 connected to the selvage of the woven fabric 6 is guided to intersect with the running path of the rapier head 7, that is, the weft 2 is guided to the catchable position of the rapier head 7.

As described above, since the weft 2 is carried to the catchable position by the cooperation of the first

guide lever 31 and the second guide lever 32, the movement amount of the first guide lever 31 can be decreased, and the second guide lever 32 can handle the residual guide distance of the weft 2 to the catchable position. Accordingly, loads applied to the first drive mechanism 51 and the second drive mechanism 52 are distributed into small loads. Stable weft insertion can be provided even when the loom is operated at a high speed.

(3) Advancement of the rapier head 7 is started toward the shed 10 of the warps 9, and a weft catching portion of the rapier head 7 intersects with a path of the weft 2. The weft catching portion of the rapier head 7 catches the weft 2. Then, a weft cutter 41 arranged close to the cloth fell 8 at the weft-supply side cuts the weft 2 at a position between the rapier head 7 and the cloth fell 8. The weft 2 let off from the weft-supply member and caught by the rapier head 7 is separated from the selvage of the woven fabric 6 at the weft-insertion side (Fig. 4B, crank angle of approximately 60°).

(4) The second guide lever 32 is retracted toward the third position P3 for retreat from a position at a crank angle of approximately 70° after the rapier head 7 catches the weft 2, as shown in Fig. 3B. In the illustrated embodiment, the second guide lever 32 rotates to an intermediate position closer to the third position P3 than the fourth position P4, and is temporarily stopped. The second guide lever 32 starts rotating again toward the third position P3 from a position at a crank angle of approximately 120°.

As described above, the purpose of the rotation of the second guide lever 32 after the rapier head 7 catches the weft 2 is to prevent the weft 2 from bending or rubbing on the weft-supply side end part of the reed 12. In particular, since the second guide lever 32 guides the weft 2 at the position farther from the cloth fell 8 than a front surface of the reed 12, the weft 2 is let off while the weft 2 bends and rubs at the weft-supply side end part of the front surface of the reed 12 during the weft insertion. The weft 2 may be damaged. However, the second guide lever 32 has a function of guiding the weft 2 at the catchable position of the rapier head 7. When the rapier head 7 catches the weft 2, the function is completed. Hence, the weft 2 need not be further guided. Thus, after the rapier head 7 catches the weft 2, the second guide lever 32 is retreated to the third position P3 at which the second guide lever 32 does not interfere with the weft 2, to prevent the weft 2 from rubbing on the weft-supply side end part of the reed 12 during the weft insertion.

Also, in this embodiment, the second guide lever 32 does not continuously rotate to the third position P3. The second guide lever 32 is temporarily stopped at the intermediate position, and then starts rotating again. This is because the second guide lever 32 may interfere with the rapier head 7 when the second

guide lever 32 extends across a running path rapier head 7 while the rapier head 7 passes through the rotation position of the second guide lever 32 in the weft insertion direction. Even in this case, to reduce rubbing of the weft 2 with respect to the reed 12, instead of the second guide lever 32 being stopped at the fourth position P4 until the rapier head 7 passes through the rotation position, the rotation of the second guide lever 32 is started immediately after the rapier head 7 catches the weft 2 even while the rapier head 7 passes through the rotation position, and the second guide lever 32 is temporarily stopped at the intermediate position at which the second guide lever 32 does not interfere with the rapier head 7. Regarding the mechanical structure, if the second guide lever 32 does not interfere with the rapier head 7, the second guide lever 32 may be rotated to the third position P3 without being stopped at the intermediate position as the illustrated embodiment.

(5) After the rapier head 7 passes through the position of the second guide lever 32 in the weft insertion direction, the second guide lever 32 rotates from the intermediate position to the third position P3 which is the retreat position (crank angle from 120° to 180°). As described above, the second guide lever 32 is operated to be restored to a standby position when the rapier head 7 catches the weft 2 or later. Accordingly, the guide position of the weft 2 can be located closer to the cloth fell 8 than the front surface of the reed 12, thereby preventing the weft 2 from rubbing on the weft-supply side end part of the reed 12 during the weft insertion.

The engagement between the second guide lever 32 and the weft 2 is released by the movement of the second guide lever 32 to the retreat position. Hence, the weft 2 is guided only by the guide hole 4 at the second position P2 in an area closer to the shed 10 than the guide hole 4 of the first guide lever 31. In this state, the guide hole 4 of the first guide lever 31 is located on a running path of the fixing guide 40. The weft 2 is inserted into the shed 10 of the warps 9 substantially in parallel to the reed 12 while the weft 2 extends along a running path of the rapier head 7 without the weft 2 rubbing on the weft-supply side end part of the reed 12 (Fig. 4C).

(6) The weft 2 is transferred at an intermediate part of the shed 10 of the warps 9 from the rapier head 7 of the insert rapier to the rapier head 71 of a carrier rapier. Then, the rapier heads 7, 71 are retracted respectively toward selvages of the woven fabric 6 and exited from the shed 10 of the warps 9 substantially simultaneously (crank angle of approximately 300°). Accordingly, the weft insertion of the weft 2 to the shed 10 of the warps 9 is completed (Fig. 4D). (7) The beating-up motion with the reed 12 is started, and driving of the first guide lever 31 is started toward the first position P1, which is the retreat position, from the second position P2 of the first guide lever

31 at a crank angle of approximately 320° (Fig. 4D, Fig. 4E). The position of the reed 12 is located at the position farther from the cloth fell 8 in the warp direction than the weft insertion position of the rapier head 7. Hence, a timing of the weft 2 to start moving toward the cloth fell 8 because of the engagement between the weft 2 and the reed 12 is not equivalent to a timing of the reed 12 to start its advancement toward the cloth fell 8 (a timing of the start of the beating-up motion). These timings have a certain interval. In this embodiment, the reed 12 starts its advancement from a crank angle of approximately 300° .

[0047] After the reed 12 starts its advancement toward the cloth fell 8, the reed 12 engages with (contacts) the inserted weft 2, and thereafter, the weft 2 starts moving to the cloth fell 8 with the reed 12 because of the advancement of the reed 12. The first guide lever 31 is driven toward the first position P1 in correspondence with the movement of the weft 2. Accordingly, the guide hole 4 of the first guide lever 31 moves toward the cloth fell 8 together with the weft 2. Thus, the weft 2 arranged between the reed 12 and the first guide lever 31 is carried to the cloth fell 8 because of the advancement of the reed 12 while the weft 2 does not substantially bend in the warp direction at the end part of the reed 12.

[0048] Part of the inserted weft 2 at the non-weft-supply side is released when the weft insertion is completed because the weft catching portion of the carrier rapier head 71 releases the weft 2. Hence, the weft 2 does not bend at the non-weft-supply side. Part of the weft 2 at the weft-supply side is guided at a fixed position by other member or device (for example, a sensor which detects running of a yarn) in an area farther from a warp array than the first guide lever 31. Hence, although the weft 2 bends to be away from the warp array at the position of the first guide lever 31 because the first guide lever 31 moves, the bending amount is small because the guide position by the other member and the first guide lever 31 in the weft insertion direction and the guide position can be desirably determined. The weft 2 is not damaged by the bending.

[0049] In the above-described embodiment, the movement of the first guide lever 31 toward the first position P1 after the rapier head 7 holds the weft 2 is performed such that, as the most preferred embodiment, the guide hole 4 of the first guide lever 31 moves in an advancement direction of the reed 12 in synchronization with that the weft 2 is carried by the reed 12 toward the cloth fell 8. An operation start timing at which the first guide lever 31 starts moving is determined as a timing at which the weft 2 engages with the reed 12 because of the reed 12 is advanced by the beating-up motion, and the weft 2 starts moving toward the cloth fell 8 together with the reed 12 (hereinafter, also referred to as "movement start timing"). With the operation mode, bending of the weft 2 can be minimized, which is advantageous.

[0050] The operation mode of the first guide lever 31 is not limited thereto. An operation mode of a first guide lever may be determined such that the movement of the guide hole 4 is started before or after the movement start timing of the weft 2 as long as the relative positional relationship between the reed 12 and the guide hole 4 is within the above-mentioned weaving allowable range. For example, the operation mode can be any of the following modes.

(1) An operation start timing may be determined to a timing before the above-mentioned movement start timing and when the rapier heads 7, 71 are exited from the shed 10 of the warps 9 or later. In particular, even when the operation start of the first guide lever 31 (guide hole 4) is a timing before the movement start timing, as long as the timing is after the rapier head 7 is exited from the shed 10 of the warps 9, the movement amount of the guide hole 4 to the cloth fell 8 in the residual running period of the weft 2 during the weft insertion is small. Hence, a distance to the reed 12 (relative distance between the reed 12 and the guide hole 4) is kept small. Accordingly, during the weft insertion (during the running of the weft 2), the weft 2 is located at a part with a large shed amount of the warps 9. Hence, sliding between the weft 2 and the warps 9 in the weft insertion direction hardly occurs. Even when sliding occurs, the sliding amount is very small. Hence, the weft 2 or the warp 9 is not markedly damaged. Weaving is not affected by the damage. Therefore, the operation start timing may be determined to the timing when the rapier heads 7, 71 are exited from the shed 10 of the warps 9 or later.

(2) An operation mode may be determined such that the first guide lever 31 (guide hole 4) moves while the rapier heads 7, 71 run in the shed 10 of the warps 9 before the movement start timing, i.e., during the weft insertion before the beating-up motion of the reed 12 is started, as long as the guide hole 4 is located within a range in which the weft 2 is guided at a part of the shed 10 of the warps 9 (namely, part with a large shed amount), in that part, sliding between the weft 2 and the warp 9 not occurring in the weft insertion direction when the weft insertion is completed. Alternatively, an operation mode may be determined such that the guide hole 4 reaches the position at which sliding between the weft 2 and the warp 9 occurs before the weft insertion is completed, as long as the guide hole 4 reaches the position at a timing which does not cause the weft 2 or the warp 9 to be markedly damaged because of sliding therebetween in the residual period until the end of the weft insertion. In any of these cases, weaving is not significantly affected. Such an operation mode can be employed.

It is to be noted that the "operation mode" takes into account not only the operation start timing of the first

guide lever 31, but also the movement speed of the first guide lever 31. In particular, regarding the position of the guide hole 4 in the warp direction, for example, the guide hole 4 may reach the same position at the same timing when the movement start timing is early and when the movement speed is first although the movement start timing is late. Hence, the operation mode of the first guide lever 31 should take into account the movement speed in addition to the movement start timing.

(3) When the movement of the guide hole 4 is started before the beating-up motion of the reed 12 is started, the tip end part of the weft 2 is located close the reed 12 by the rapier head 71, and the part of the weft 2 at the weft-supply side is guided by the guide hole 4 which is separated from the reed 12. Hence, when the weft insertion is completed, the weft 2 is not parallel to the reed 12, but has an angle with respect to the reed 12. When the beating-up motion of the reed 12 is performed, the reed 12 gradually engages with the weft 2 from a part at the non-weft-supply side. In some cases, the weft 2 may bend during the beating-up motion, and the weft 2 may be beaten up in such a state, resulting in a defectively woven part appearing. Owing to this, the operation mode of the first guide lever 31 may be determined with regard to an angle defined by the reed 12 and a line connecting the guide hole 4 and the carrier rapier head 71 at the end of the weft insertion. The position of the rapier head 71 at the end of the weft insertion is basically constant. The above-mentioned angle can be replaced with the position of the guide hole 4 in the warp direction, i.e., a relative distance between the reed 12 and the guide hole 4 in the warp direction.

(4) When the operation start timing of the first guide lever 31 is determined after the movement start timing, an operation mode is determined in consideration with the bending state of the weft 2 at the weft-supply side end part of the reed 12. In particular, when the operation start of the first guide lever 31 (guide hole 4) is determined to a timing after the movement start timing, the weft 2 engages with the end part of the reed 12 and bends to be away from the cloth fell 8 in a period from the movement start timing until the first guide lever 31 starts its operation. The bending degree increases as the operation start timing of the first guide lever 31 is later, that is, as the relative distance between the reed 12 and the guide hole 4 increases. The bending state of the weft 2 varies in accordance with a difference between a movement speed of the first guide lever 31 and a beating-up motion speed of the reed 12. The influence of the bending state applied to the weft 2 may vary depending on the type of the weft 2. Also, an allowable range of the influence applied to the weft 2 may vary depending on the quality of the woven fabric. Hence, a range of bending degrees allowable

with regard to the type of the weft 2 and the quality of the woven fabric, that is, a range of relative distances between the reed 12 and the guide hole 4 may be determined. Then, the operation mode of the first guide lever 31 may be determined to fall in the range. Preferably, an operation mode may be determined such that a movement speed of the first guide lever 31 is higher than an advancement speed of the reed 12, so as to gradually decrease bending of the weft 2 at beating up.

[0051] The present invention is not limited to the illustrated embodiment, and may be implemented through modifications as follows.

(1) In the above-described embodiment, the weft insertion device of a single color has been described, which inserts the weft 2 supplied from a single weft-supply member. The present invention is not limited thereto. A weft insertion device of multiple colors can be used, which inserts wefts 2 supplied from at least two weft-supply members (the types of the wefts 2 may be the same or may be different).

Fig. 5A and 5B illustrate an example drive mechanism 11 provided in a weft insertion device of two colors to which the present invention is applied. To correspond to the two colors, two first guide levers 31 and two first drive motors 21 are provided. In addition, a second guide lever 32 and a second drive motor 22 are provided, which are commonly used for the two colors. The two first drive motors 21 are selectively operated on the basis of the order of selection of the wefts 2. The one second drive motor 22 provides a guide operation for any of the wefts 2. In this example, a first drive mechanism 51 includes two first drive motors 21 and two first guide levers 31. Fig. 6 illustrates an example weft guide mechanism 5 provided in a weft insertion device of three colors. To correspond to weft insertion of the three colors, three first guide levers 31 are provided. The first guide levers 31 are respectively driven by three first drive motors 21 (not shown). Also, a second guide lever 32 is provided, which is common to the respective colors. In this example, a first drive mechanism 51 includes three first drive motors 21 and three first guide levers 31.

(2) The configuration of the first drive mechanism 51 may employ the following modification instead of that of the embodiment.

(2-1) Regarding the coupling structure between the first guide lever 31 and the rotatable lever 27, instead of coupling through the roller 30 as the above-described embodiment, a link member 42 may be arranged between a first guide lever 31 and a rotatable lever 27, and pins 43 may be provided at both ends of the link member 42 to provide link coupling, as shown in Fig. 7.

In this case, the rotatable lever 27, the link member 42, and the pins 43 define a first drive mechanism 51.

(2-2) The first guide lever 31 may not be linearly advanced or retracted. Referring to Fig. 8, a first guide lever 31 may be rotated, so that a guide hole 4 is displaceable between the first position P1 and the second position P2. In this example, part of the first guide lever 31 also serves as a member which defines part of the first drive mechanism 51.

(2-3) The drive sources may not be the dedicated drive motors (21, 22). The drive sources may use a drive motor of a loom, as the drive sources. The operation of the first and second levers (31, 32) may be achieved by cams. Hence, the cams rotated by the drive motor of the loom may be used as the drive source to cause the levers (31, 32) to move.

(2-4) The first drive mechanism 51 which causes the first guide lever 31 to linearly reciprocate may be provided by a combination of a pinion and a rack, the pinion rotated by the first drive motor 21, the rack attached to the first guide lever 31. Alternatively, the drive source may employ a linear motor or an air cylinder to directly drive the first guide lever 31.

(3) As described above, in the present invention, the second guide lever 32 does not have to be provided. The first guide lever 31 may also serve as the second guide lever 32 in the above-described embodiment. In particular, the second guide lever 32 may be omitted as long as the guide hole 4 of the first guide lever 31 can be moved to a position at which the weft 2 is guided at the catchable position before the start of the weft insertion.

[0052] When the second guide lever 32 is omitted, the first guide lever 31 may perform the operation (movement to the retreat position) performed by the second guide lever 32 after the rapier head 7 catches the weft 2 in the above-described embodiment. However, regarding the above-described embodiment, the operation of the first guide lever 31 at this time does not provide movement to the retreat position (first position P1). The first guide lever 31 is temporarily stopped at the second position P2 (intermediate position) of the above-described embodiment, and then the movement to the first position P1 is started in synchronization with the beating-up motion.

[0053] When the single weft guide lever 3 (first guide lever 31) performs the all operations mentioned above, a load to be applied to the drive mechanism may increase because of an increase in speed of the loom. Owing to this, in the case of motor drive type, the weft guide lever

3 (first guide lever 31) may not follow a target operation. In the case of mechanical drive type, the drive mechanism may be damaged. Therefore, a preferred embodiment may be the above-described embodiment, in which the weft 2 is guided by cooperation of the two guide levers (first guide lever 31 and second guide lever 32).

[0054] The present invention is not limited to a both-side rapier loom as the embodiment, and may be applied to a one-side rapier loom in which weft insertion is performed such that a single rapier head runs from the weft-supply side to the non-weft-supply side.

Claims

1. A weft insertion method of a rapier loom, the rapier loom including a weft insertion device (1), the weft insertion device (1) including a weft guide mechanism (5), the weft guide mechanism (5) including a weft guide lever (3) having a guide hole (4) at a tip end part of the weft guide lever (3), a weft (2) being inserted through the guide hole (4), the weft guide mechanism (5) guiding the weft (2) connected to a woven fabric (6) to a catchable position, at which a rapier head (7) is capable of catching the weft (2), wherein the weft guide mechanism (5) is capable of causing the weft guide lever (3) to reciprocate to selectively locate the guide hole (4) between a first position (P1) and a second position (P2), the first position (P1) being a retreat position closer to a cloth fell (8) than a running path of the rapier head (7) in a warp direction, the second position (P2) being a position farther from the cloth fell (8) than the first position (P1) in the warp direction, the second position (P2) being also a guide position closer to the running path of the rapier head (7) than the cloth fell (8), and wherein the method comprising the step of driving the weft guide lever (3) to move such that the guide hole (4), which is arranged at the second position (P2) at start of weft insertion, moves toward the first position (P1) before a reed (12) performs beating up.
2. The weft insertion method of the rapier loom according to claim 1, wherein an operation mode of the weft guide lever (3) is determined such that a relative positional relationship between the reed (12) and the guide hole (4) in the warp direction is within a weaving allowable range.
3. The weft insertion method of the rapier loom according to claim 1 or 2, wherein the movement of the weft guide lever (3) toward the first position (P1) is started when the rapier head (7) is exited from a shed (10) of warps (9) or later.
4. The weft insertion method of the rapier loom according to any of claims 1 to 3, wherein the weft insertion

mechanism (5) further includes a second guide lever (32) in addition to the weft guide lever (3), which serves as a first guide lever (31), the second guide lever (32) being farther from the cloth fell (8) than the first guide lever (31) and guiding the weft (2) to the catchable position of the rapier head (7) in cooperation with the first guide lever (31), the second guide lever (32) being driven to reciprocate between a third position (P3) as a retreat position and a fourth position (P4) as a guide position at the start of the weft insertion.

5. The weft insertion method of the rapier loom according to claim 4, wherein the second guide lever (32), which guides the weft (2) at the fourth position (P4) at the start of the weft insertion, is moved toward the third position (P3) as the retreat position when the rapier head (7) catches the weft (2) or later.

6. A weft insertion device (1) of a rapier loom, comprising:

a weft guide mechanism (5),
wherein the weft guide mechanism (5) includes

a weft guide lever (3) having a guide hole (4) at a tip end part of the weft guide lever (3), a weft (2) being inserted through the guide hole (4); and
a drive mechanism (11) driving the weft guide lever (3),
wherein the weft guide mechanism (5) guides the weft (2) connected to a woven fabric (6) to a catchable position, at which a rapier head (7) is capable of catching the weft (2), and

wherein the drive mechanism (11) causes the weft guide lever (3) to reciprocate to selectively locate the guide hole (4) between a first position (P1) and a second position (P2), the first position (P1) being a retreat position closer to a cloth fell (8) than a running path of the rapier head (7) in a warp direction, the second position (P2) being a position farther from the cloth fell (8) than the first position (P1) in the warp direction, the second position (P2) being also a guide position closer to the running path of the rapier head (7) than the cloth fell (8), the drive mechanism (11) also driving the weft guide lever (3) such that the guide hole (4) at the second position (P2) starts moving toward the first position (P1) before a reed (12) performs beating up.

7. The weft insertion device (1) of the rapier loom according to claim 6, wherein the drive mechanism (11) drives the weft guide lever (3) with an operation mode determined such that a relative positional relation-

ship between the reed (12) and the guide hole (4) in the warp direction is within a weaving allowable range.

8. The weft insertion device (1) of the rapier loom according to claim 6 or 7, wherein the drive mechanism (11) drives the weft guide lever (3) to start moving toward the first position (P1) when the rapier head (7) is exited from a shed (10) of warps (9) or later.
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9. The weft insertion device (1) of the rapier loom according to any of claims 6 to 8, wherein, in addition to the weft guide lever (3), which serves as a first guide lever (31), and the drive mechanism (11), which serves as a first drive mechanism (51), the weft insertion mechanism (5) further includes a second guide lever (32) being farther from the cloth fell (8) than the first guide lever (31) and guiding the weft (2) to the catchable position, at which the rapier head (7) is capable of catching the weft (2) in cooperation with the first guide lever (31), and a second drive mechanism (52) driving the second guide lever (32) to reciprocate between a third position (P3) as a retreat position and a fourth position (P4) as a guide position selected at the start of the weft insertion.
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10. The weft insertion device (1) of the rapier loom according to claim 9, wherein the second drive mechanism (52) causes the second guide lever (32), which guides the weft (2) at the fourth position (P4) at the start of the weft insertion, to move toward the third position (P3) as the retreat position when the rapier head (7) catches the weft (2) or later.
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FIG. 1

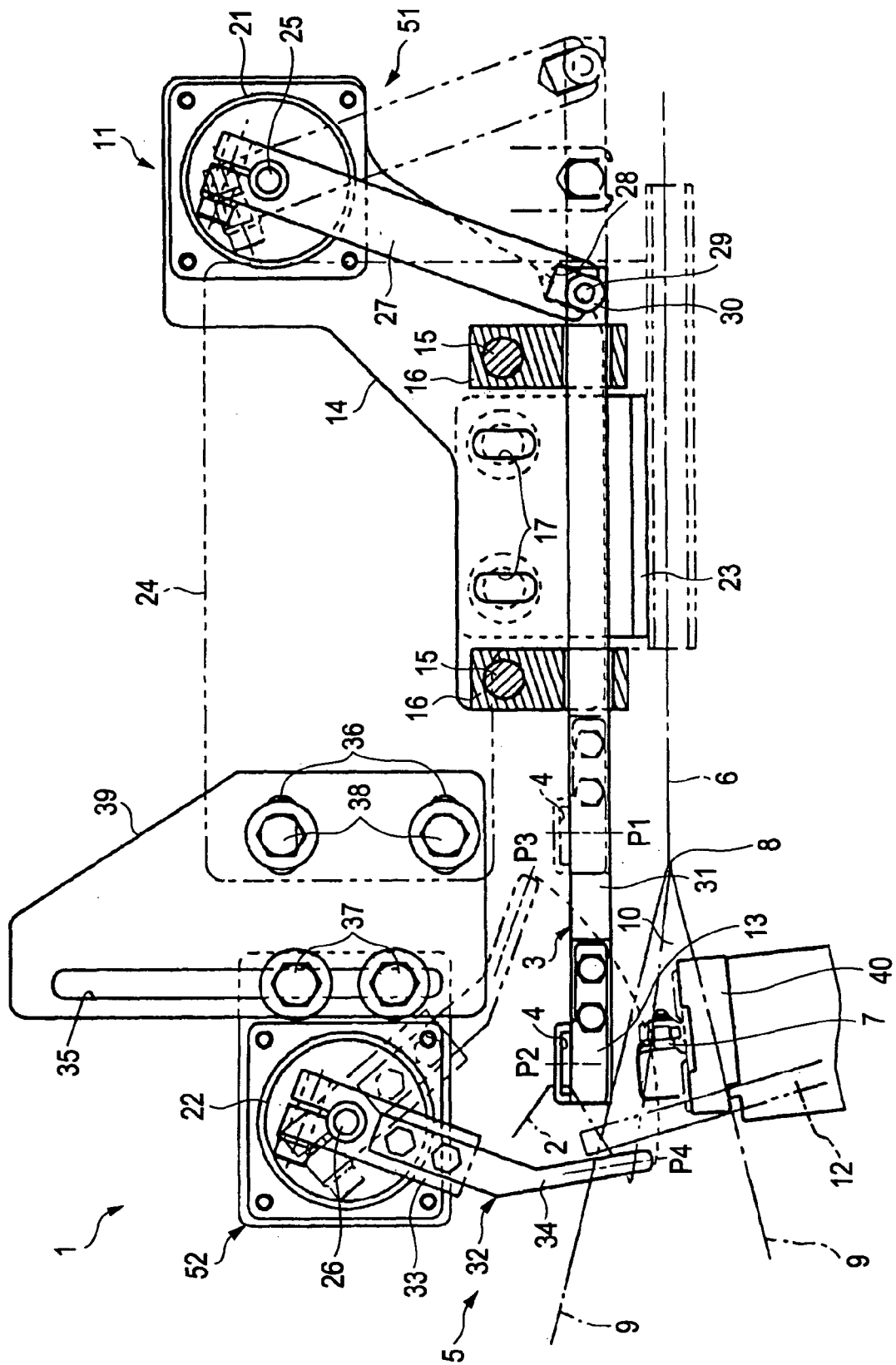


FIG. 2

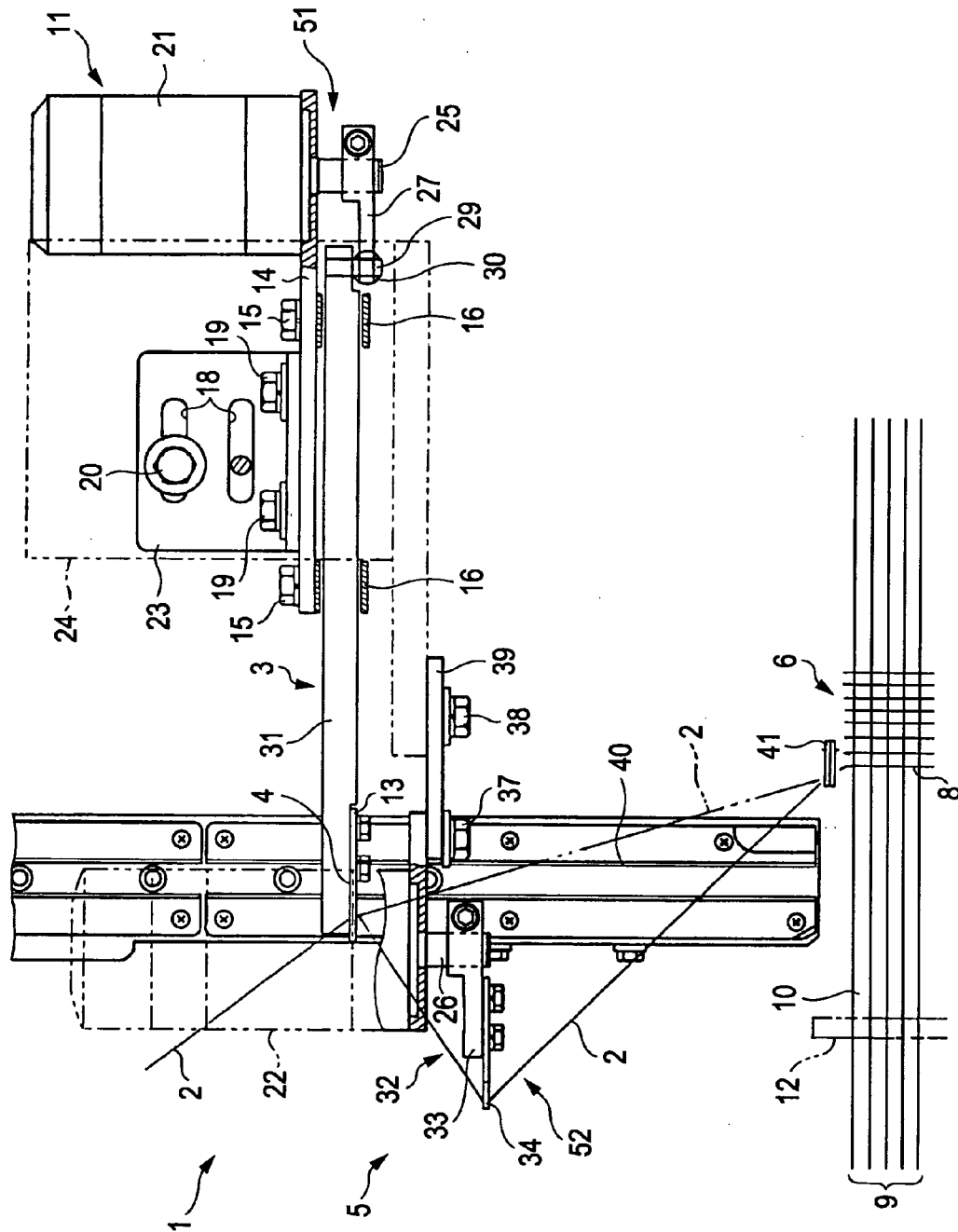


FIG. 3A

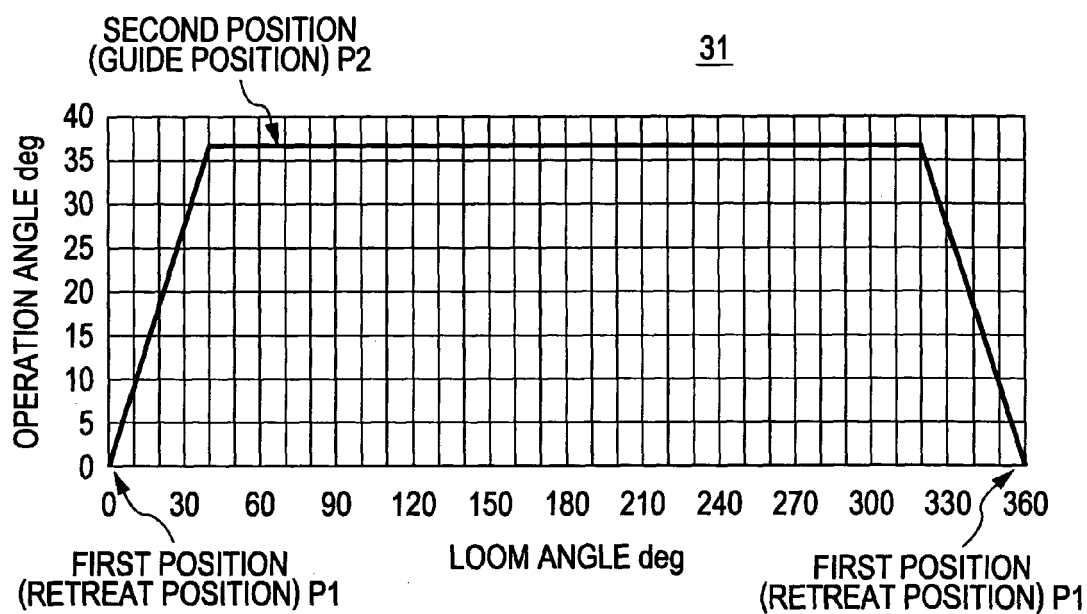


FIG. 3B

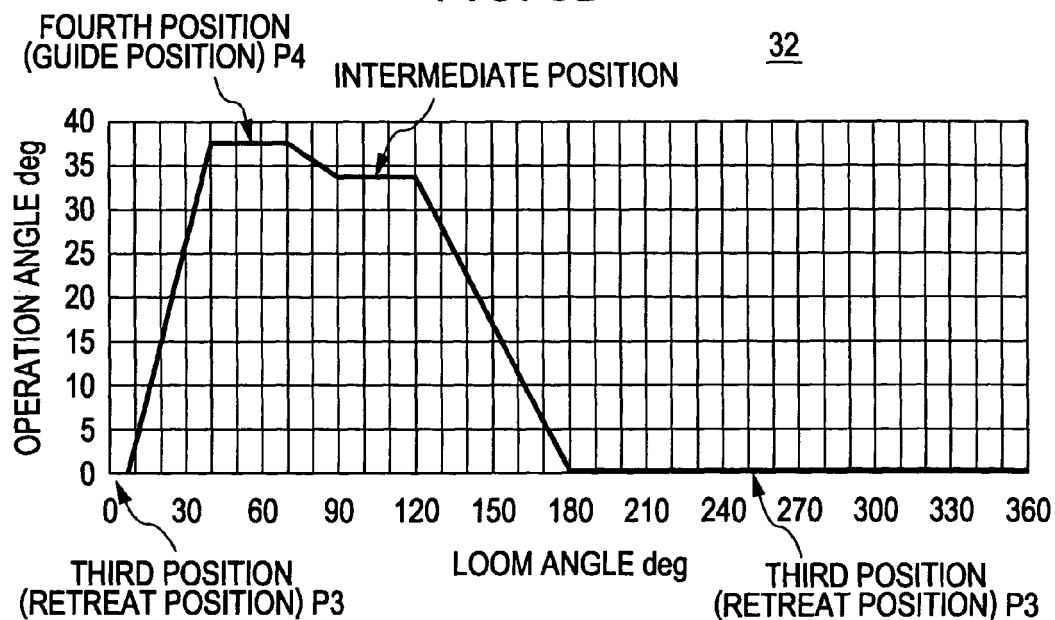


FIG. 4A

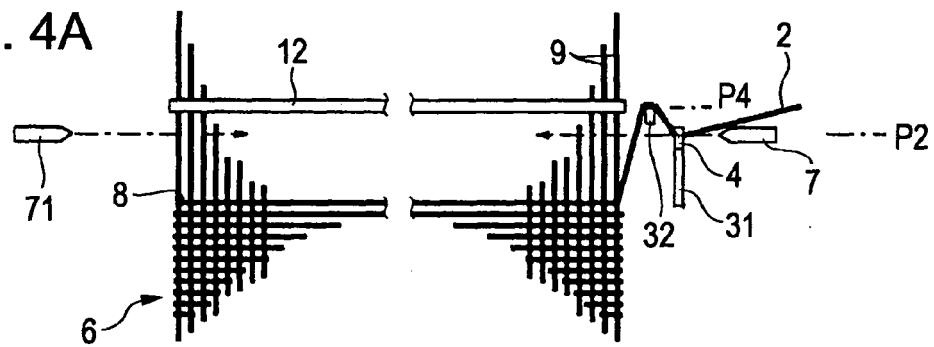


FIG. 4B

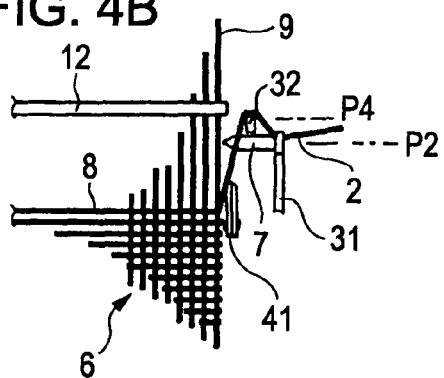


FIG. 4C

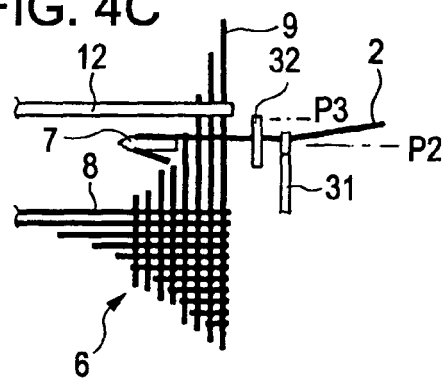


FIG. 4D

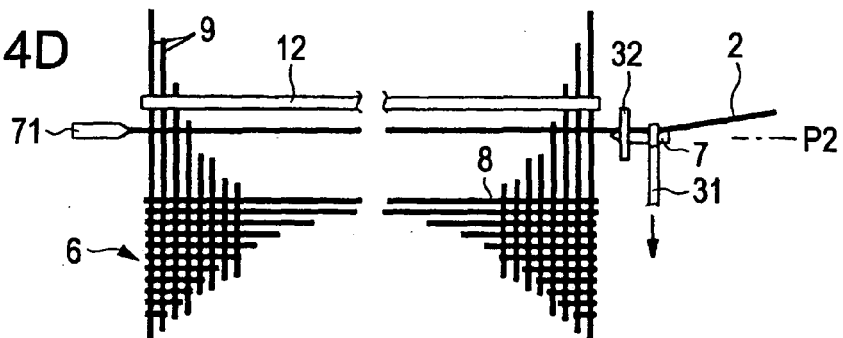


FIG. 4E

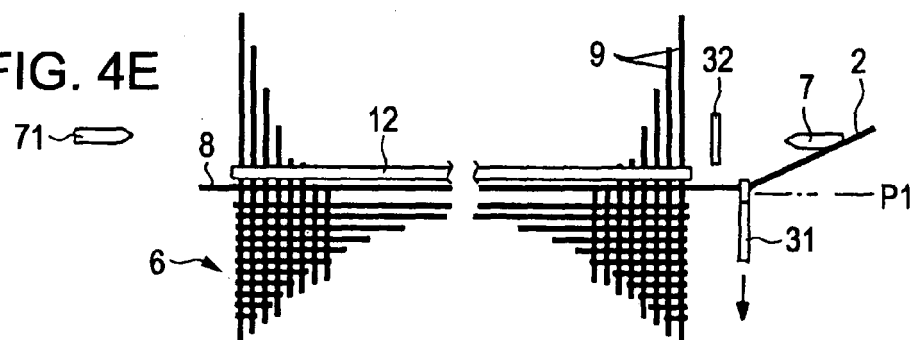


FIG. 5A

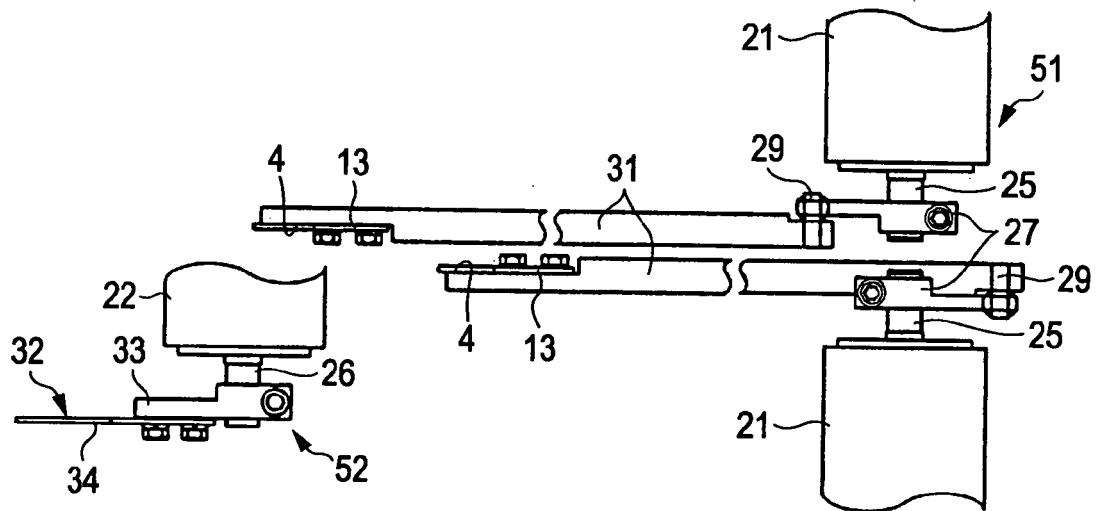


FIG. 5B

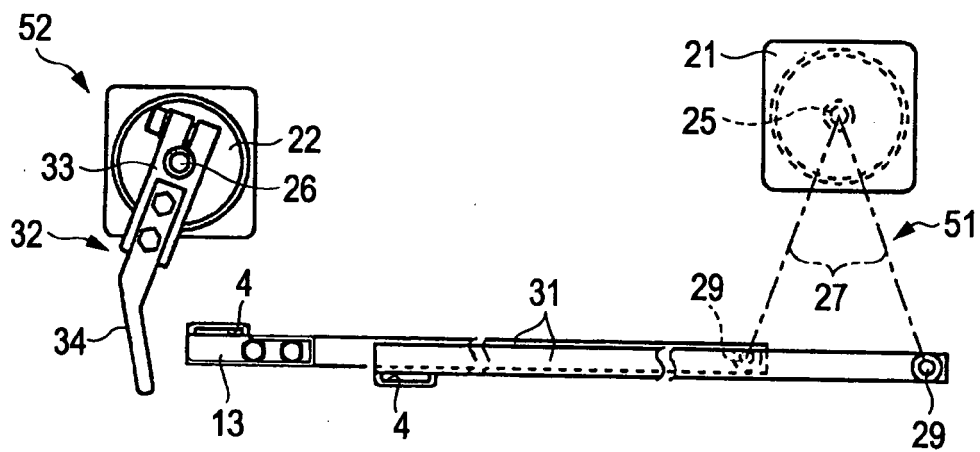


FIG. 6

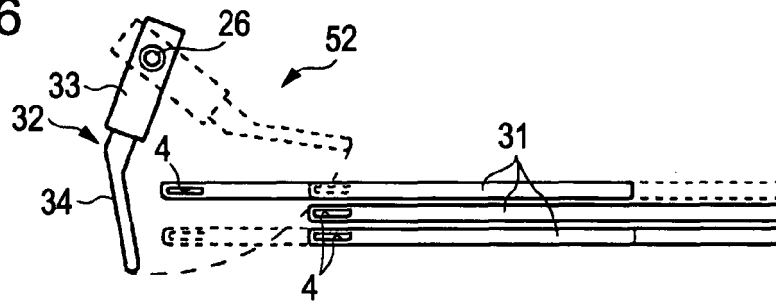


FIG. 7

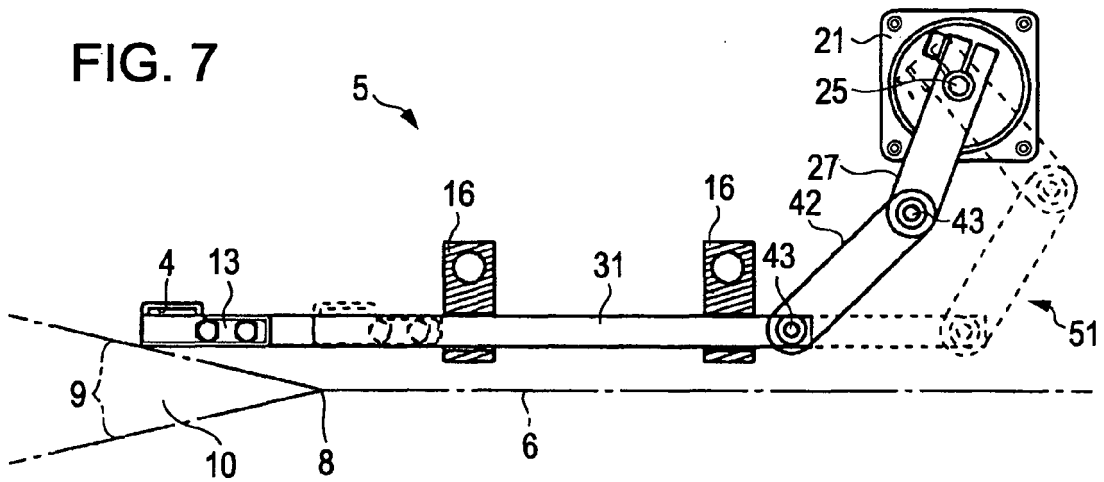
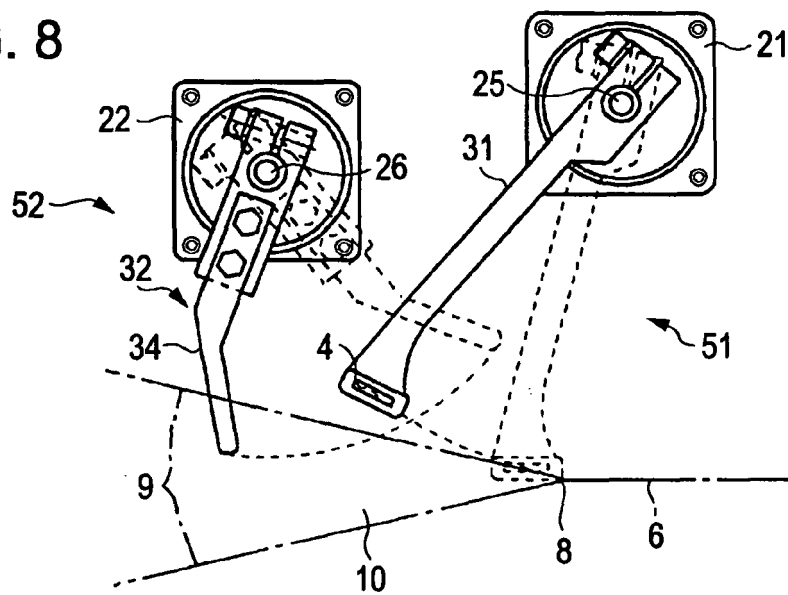


FIG. 8





EUROPEAN SEARCH REPORT

Application Number
EP 09 01 3498

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2008/009332 A (PICANOL NV [BE]; D HOOP TOM [BE]; CORNELISSEN PHILIP [BE]) 24 January 2008 (2008-01-24) * pages 2-13; claims 1,9,10; figures 1-5,7 *	1-10	INV. D03D47/00 D03D47/34 D03D47/38
A	----- WO 2005/047584 A (PICANOL NV [BE]; ROELSTRAETE KRISTOF [BE]) 26 May 2005 (2005-05-26) * figures 1-10 * -----	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			D03D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 February 2010	Examiner Iamandi, Daniela
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