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(71) Applicant: **Tsudakoma Kogyo Kabushiki Kaisha**
Kanazawa-shi, Ishikawa 921-8650 (JP)

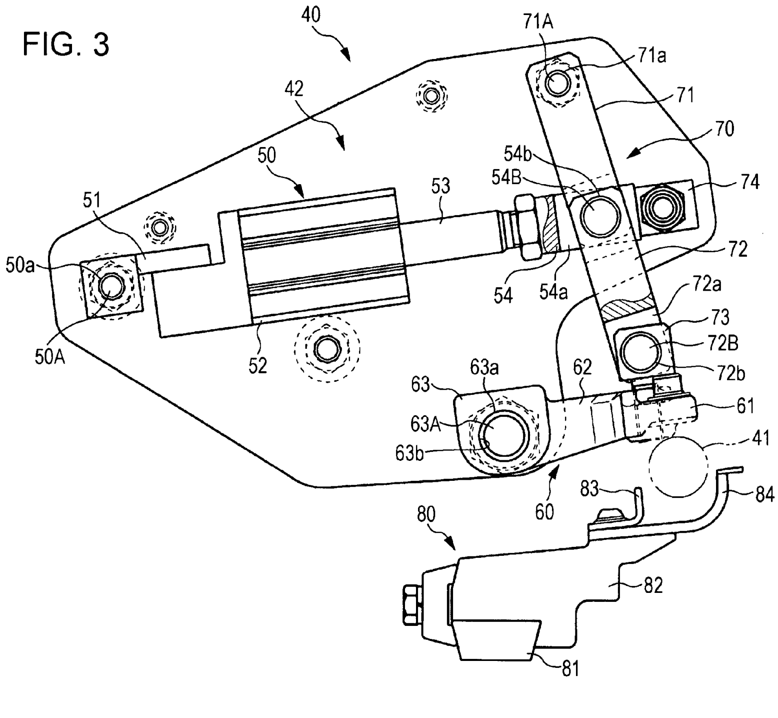
(72) Inventors:
- **Kakutani, Kazuto**
Kanazawa-shi
Ishikawa-ken 921-8650 (JP)
- **Itou, Naoyuki**
Kanazawa-shi
Ishikawa-ken 921-8650 (JP)

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

(54) **Temple device for loom including automatic temple position switching mechanism and method of driving temple thereof**

(57) Provided is a method of driving a temple (41) of a temple device (40) including an automatic temple position switching mechanism (42), the temple device (40) being used for a loom that weaves a fabric (2a) having two or more weave sections with different weft densities, the automatic temple position switching mechanism (42) automatically switching a position of the temple (41) between two positions that are an operating position and a standby position, the method being performed when displacing the temple (41) from the standby position toward the operating position in accordance with switching between the weave sections, the method including storing an operation mode related to movement of the temple (41) beforehand, and controlling the movement of the temple (41) in accordance with the stored operation mode in accordance with switching between the weave sections.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a temple device for a loom including an automatic temple position switching mechanism and a method of driving a temple of the temple device. In particular, the present invention relates to a loom for weaving a fabric including two or more weave sections having different weft densities (for example, a tire cord fabric whose weave section includes a tire fabric section and a tabby section). The loom includes a temple (for example, a ring temple) and a temple device that includes a mechanism (for example, an automatic elevator mechanism) that displaces the temple between two positions, i.e., an operating position and a standby position by using an actuator as a drive source. The temple device automatically switches the position of the temple between the two positions in accordance with the density of a fabric to be woven. Regarding such a loom, the present invention relates to drive-control of an automatic temple position switching mechanism (automatic temple-elevating mechanism) that is performed when displacing the temple device from the operating position toward the standby position (when the weave section changes from the tabby section to the fabric section, in the case of a tire cord fabric).

2. Description of the Related Art

[0002] In a general loom, temple devices are disposed at both ends in the weaving-width direction of a fabric to prevent a portion of the fabric near the cloth fell from being crimped when the fabric is woven. A ring temple is a known example of a temple used in such a temple device. The ring temple includes a plurality of temple rings that are arranged parallel to one another along the weaving-width direction, and each of the temple rings has multiple pins on the outer peripheral surface thereof.

[0003] Such a temple device is used not only when weaving a general fabric but also when weaving a rubber-reinforcing fabric such as a tire cord fabric. When weaving a tire cord fabric, a body portion having a very low weft density (so-called "tire fabric section") and a tab portion having a high weft density (so-called "tabby section") are alternately woven. The temple is made to act on the fabric when weaving the tabby section and the temple is separated from the fabric when weaving the tire fabric section.

[0004] There is a temple device, which is used in a loom for weaving a tire cord fabric, including a mechanism (automatic temple position switching mechanism) that automatically switches the position of a temple (Japanese Unexamined Patent Application Publication No. 4-281041). The automatic temple position switching mechanism includes a pneumatic cylinder to which the temple is attached. The pneumatic cylinder moves the temple between a first position (standby position) and a second position (operating position).

[0005] As described in Japanese Unexamined Patent Application Publication No. 4-281041, when weaving a fabric (tire cord fabric) including two or more weave sections having different weft densities, i.e., a first weave section having a very low weft density such as a tire fabric section and a second weave section having a high weft density such as a tabby section, the first weave section is woven when the temple has been moved to a first position (standby position) at which the temple is separated (retracted) from the fabric. The reason for this operation will be described below in detail.

[0006] As with the case of a general fabric, when weaving the second weave section having a high weft density, the fabric tends to be crimped when the fabric is woven. Therefore, it is necessary to locate the temple at the second position (operating position, i.e., a position at which the fabric engages with the temple and is pressed against the temple) so that the temple can exert a crimp prevention effect to the fabric.

[0007] In contrast, when weaving the first weave section having a very low density, such as the tire fabric section, it is not necessary to prevent crimping by using a temple, because the fabric is only negligibly crimped when the fabric is woven. Moreover, in the first weave section having a very low weft density, warp applies only a weak binding force to weft, so that the positions of warp and weft are easily displaced from each other. Therefore, if the first weave section is continuously pressed by a temple, the weft and the warp may be disarranged and the quality of the fabric may be reduced. Therefore, when weaving the first weave section, it is preferable that the temple be retracted to the first position (standby position) at which the temple is separated from the fabric.

[0008] For such a reason, in the loom described in Japanese Unexamined Patent Application Publication No. 4-281041, the operation of the pneumatic cylinder is controlled so that the position of the temple is automatically moved (displaced) from the operating position to the standby position or from the standby position to the operating position depending on which of the first and second weave sections having different weft densities is to be woven.

SUMMARY OF THE INVENTION

[0009] However, when switching the weave section from the first weave section (low density) to the second weave section (high density), if the temple is displaced from the standby position to the operating position in an inappropriate operation mode, such as at an inappropriate movement start timing, the following problems occur.

[0010] The temple is disposed at a position distanced toward a take-up side from the cloth fell with respect to the warp direction. Therefore, when the weave section is switched, the first weave section is located below the temple, which is at the standby position. In this case, if the temple is displaced too early relative to the movement of the fabric and the temple reaches the position of fabric too early, which may occur if the temple is displaced at the same time as the weave sections is switched, the temple is pressed against the first weave section, which has a low weft density. In the first weave section, which has a very low density, warp yarns are exposed in spaces between adjacent weft yarns that have been inserted. Therefore, if the temple presses the first weave section from above, warp yarns may enter the spaces between adjacent temple rings of the temple, whereby the warp yarns may be damaged.

[0011] On the other hand, if the temple reaches the position of the fabric too late, weft yarns are densely inserted without being restrained by the temple for a long time. As a result, the fabric may flutter, whereby the position of cloth fell (warp shed) may become unstable and weft insertion may be hampered.

[0012] An object of the present invention, which has been achieved with consideration of the above-described circumstances, is to optimally control the operation mode in which a temple is displaced between a standby position and an operating position in a loom including a temple device having an automatic position switching mechanism (automatic elevating device) that automatically displaces the temple between the operating position and the standby position, and thereby to avoid the above-described problems.

[0013] A first aspect of the invention provides a method of driving a temple of a temple device including an automatic temple position switching mechanism, the temple device being used for a loom that weaves a fabric having two or more weave sections with different weft densities, the temple being displaceable between two positions that are an operating position and a standby position, the automatic temple position switching mechanism automatically switching a position of the temple between the two positions in accordance with a density of a fabric to be woven.

[0014] The method is performed when displacing the temple from the standby position toward the operating position in accordance with switching between the weave sections, and the method includes storing an operation mode related to movement of the temple beforehand, and controlling the movement of the temple in accordance with the stored operation mode in accordance with switching between the weave sections.

[0015] The operation mode of moving a temple may include a movement start timing of the temple, a movement speed of the temple, and a combination of these.

[0016] The operation mode may be determined on the basis of, for example, operation conditions of the temple (such as the movement speed of the temple, the distance that the temple moves from the standby position to a position at which the temple engages with the fabric, and the distance between the cloth fell and a position at which the temple starts engaging with the fabric when the temple is lowered). Alternatively, the operation mode may be determined on the basis of a weaving condition. Examples of the weaving condition includes the weft density of the weave section after being switched and the number of revolutions of the loom.

[0017] The operation mode may be set, for example, manually. Alternatively, the operation mode may be automatically calculated on the basis of a weaving condition that has been set in the loom.

[0018] A second aspect of the present invention provides a temple device for a loom, the temple device including a temple and an automatic temple position switching mechanism, the temple device being used for the loom that successively weaves a fabric having two or more weave sections with different weft densities in accordance with a set weaving length that has been set beforehand for each of the weave sections while monitoring a weaving length of each of the weave sections, the loom including switching command means that outputs a command signal for instructing switching between the weave sections when the weaving length of the weave section that is being woven reaches the set weaving length, the temple being displaceable between two positions that are an operating position and a standby position, the automatic temple position switching mechanism automatically switching a position of the temple between the two positions in accordance with a density of a fabric to be woven by using an actuator as a driving source.

[0019] The temple device includes storage means that stores an operation mode related to movement of the temple beforehand, and control means that controls driving of the actuator of the automatic temple position switching mechanism on the basis of the command signal from the switching command means and the operation mode stored in the setting storage means.

[0020] An operator may set and store, for example, one of the movement start timing and the movement speed of the temple as an operation mode of the temple in the setting storage means. The setting storage means may include a calculator that calculates a movement start timing and/or a movement speed of the temple on the basis of a weaving condition set in the loom.

[0021] With the present invention, movement of the temple is not started when the weave sections are switched. Instead, an operation mode of the temple (such as the movement start timing and the movement speed) is set and stored beforehand, and the temple is moved in accordance with the stored operation mode by using the timing at which the weave sections are switched as a reference, so that the temple can be made to start engaging with the fabric at an appropriate position.

[0022] In particular, by determining the operation mode on the basis of a weaving condition (such as the number of revolutions of the loom or the weft density of the weave section to be woven after switching), the temple can be made to start engaging with the fabric at the optimal position.

[0023] Moreover, by automatically calculating the operation mode on the basis of the weaving condition that has been set in the loom, an operator need not calculate the operation mode and perform input and setting operations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

Fig. 1 illustrates a fabric weaving unit and other units of a tire cord fabric loom according to the present invention;
Fig. 2 illustrates an overview of control of the fabric weaving device illustrated in Fig. 1;
Fig. 3 is a side view of a temple device when the loom is weaving a tabby section;
Fig. 4 illustrates the temple device when the loom is weaving a tire fabric section;
Fig. 5 is a plan view of the temple device;
Fig. 6 is a block diagram of a system for driving a cylinder of the temple device; and
Fig. 7 is a block diagram of a modification of the system for driving the cylinder of the temple device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] Fig. 1 illustrates a tire cord fabric loom to which the present invention is applied. A general tire cord fabric loom includes a yarn supply unit 1, a fabric weaving device 2, and a take-up device 3, which are independently provided. The yarn supply unit 1 supplies a large number of warp yarns 1a as a warp row 1b (hereinafter also referred to as a "warp sheet"). The fabric weaving device 2 makes a fabric 2a by inserting weft (not shown) into the warp sheet 1b. The take-up device 3 takes up the fabric 2a. A tire cord fabric, which is the fabric 2a, and the parts of the tire cord fabric loom will be described below in detail.

[0026] A tire cord fabric is a rubber-reinforcing fabric that is used for making a carcass layer of a rubber tire. The tire cord fabric includes two weave sections (not shown) having significantly different weft densities: a tire fabric section having a very low weft density, and a tabby section having a weft density higher than that of the tire fabric section. The carcass layer is manufactured by coating the tire fabric section of the tire cord fabric with a rubber material.

[0027] The yarn supply unit 1 includes a creel device (not shown) and a tension device 4. The creel device includes a large number of pegs that protrude from a strut or the like. The number of the pegs is the same as the number of the warp yarns 1a, and each of the pegs supports a yarn supply package. A yarn is supplied toward the tension device 4 from each of the yarn supply packages, and thereby a warp row is formed.

[0028] The tension device 4 aligns a large number of yarns, which have been pulled out of the creel device, in the lateral direction so that the yarns extend parallel to each other, and the yarns are guided to a dancer roller 4b along a path in which a plurality of guide rollers 4a are disposed. The dancer roller 4b applies a tension to the yarns so that a substantially equal tension is applied to each of the yarns that have been pulled out of the yarn supply package. Subsequently, the fabric weaving device 2 makes the large number of yarns into the warp sheet 1b, and the warp sheet 1b is output toward the take-up device 3.

[0029] In the example illustrated in Fig. 1, the take-up device 3 is a so-called off-loom take-up device that performs contact take-up. The take-up device 3 includes a drive roller 3a, which is rotated, and a driven roller 3b, which is rotatable. A take-up roller 3c is disposed above the drive roller 3a and the driven roller 3b, and one end of the fabric 2a is wound around the take-up roller 3c. In addition to the drive roller 3a and the driven roller 3b, a guide roller 3d is provided in the take-up device 3. When the take-up roller 3c rotates in contact with the drive roller 3a, the fabric 2a, which has been woven, is guided by the guide roller 3d and the driven roller 3b, and is wound around the take-up roller 3c.

[0030] Fig. 2 illustrates an enlarged view of the fabric weaving device 2 of Fig. 1. The structure of the fabric weaving device 2 is the same as that of an ordinary loom, except for the following. An ordinary loom supplies a warp sheet, which is wound around a let-off beam, to a fabric weaving unit by rotating the let-off beam. In contrast, the tire cord fabric loom illustrated in Fig. 2 supplies the warp sheet 1b, which has passed through the tension device 4, to a fabric weaving unit 7 by letting off the warp sheet 1b by a desired let-off amount using a let-off mechanism 5 of the weaving device.

[0031] The let-off mechanism 5 includes a nip roller 5a, a let-off roller 5b, and a let-off motor 5c for rotating the let-off roller 5b. The warp sheet 1b is wound around and nipped between the nip roller 5a and the let-off roller 5b, and is let off due to the rotation of the let-off roller 5b. The let-off roller 5b corresponds to a warp beam of a general loom.

[0032] The warp sheet 1b, which has been let off from the let-off mechanism 5, passes a guide roller 6a, and is wound around and guided by a tension roller 6b. A tension detector 6c is connected to the tension roller 6b, and the tension detector 6c detects the warp tension by detecting a load applied to the tension roller 6b due to the warp tension.

[0033] The fabric weaving unit 7 makes the fabric 2a by inserting weft into the warp sheet 1b. Subsequently, the fabric 2a is let off toward the take-up device 3 (off-loom take-up device) by a take-up mechanism 8. In Fig. 2, a heald frame 7a is illustrated.

[0034] The take-up mechanism 8 includes a pair of press rollers 8a, a take-up roller 8b that is in pressed contact with the press rollers 8a, and a take-up motor 8c for rotating the take-up roller 8b. The fabric 2a, which has be woven by the fabric weaving unit 7, is guided by a guide roller 7b toward the take-up mechanism 8; is wound around the press roller 8a, the take-up roller 8b, and the press roller 8a in this order; and is nipped between the press roller 8a and the take-up roller 8b. Thus, when the take-up roller 8b is rotated, the fabric 2a is let off toward the take-up device 3 with a let-off amount (speed) in accordance with a preset weft density.

[0035] A take-up control device 20 controls driving of the take-up motor 8c of the take-up mechanism 8. A let-off control device 10 controls driving of the let-off motor 5c of the let-off mechanism 5. The let-off mechanism 5, the let-off control device 10, and the like correspond to a "let-off device" in the present invention.

[0036] The basic function of the let-off control device 10 is as follows. The let-off control device 10 calculates the basic speed from the number of revolutions of the loom and the weft density that have been set in a loom control device 30, calculates a speed correction value from the deviation of the warp tension detected by the tension detector 6c from the target warp tension that has been set, and calculates a command speed by correcting the basic speed using the speed correction value. The let-off control device 10 calculates the actual number of revolutions of the let-off motor 5c from a signal sent from an encoder 5d that detects the rotation angle of the drive shaft of the let-off motor 5c, and performs tension control by driving the let-off motor 5c so that the actual number of revolutions of the let-off motor 5c becomes the same as the command speed. As a result, the amount of warp let-off is controlled, and the warp tension is adjusted.

[0037] The take-up control device 20 calculates the number of revolutions and the like of a main shaft 9a of the loom on the basis of a signal from an encoder 9b that detects the rotation angle of the main shaft 9a. The take-up control device 20 controls driving of the take-up motor 8c in sync with the rotation of the main shaft 9a of the loom so that the take-up motor 8c rotates with a rotation speed corresponding to the weft density that has been set in the loom control device 30. That is, because the weft density and the number of revolutions of the main shaft 9a of the loom differ between the tire fabric section and the tabby section, driving of the take-up motor 8c is controlled so that the rotation speed of the take-up motor 8c matches that for either of these sections. To do so, as with the let-off control device 10, the take-up control device 20 calculates the actual number of revolutions of the take-up motor 8c on the basis of a signal from an encoder 8d of the drive shaft of the take-up motor 8c, and the take-up control device 20 controls driving of the take-up motor 8c so that the actual rotation speed of the take-up motor 8c matches the rotation speed for the weave section.

[0038] The above-described tire cord fabric loom includes a pair temple devices each disposed at an end portion thereof in the weaving-width direction and near the cloth fell in a downstream part thereof in the direction in which warp moves. The pair of temple devices are laterally symmetric with each other. Therefore, in the following description, as illustrated in Figs. 3 to 5, only a temple device 40 that is disposed on one of the sides in the weaving-width direction will be described.

[0039] Fig. 3 is a side view of the temple device 40, which is disposed on a side of the weaving-width direction, in a state in which a fabric (not shown) is in pressed contact with a ring temple 41. Fig. 4 illustrates a state in which the ring temple 41 is separated from a fabric (not shown). Fig. 5 is a plan view of the temple device 40.

[0040] As with the temple device described in "Description of the Related Art", the temple device 40 includes the ring temple 41 that is engageable with the fabric 2a, and an automatic temple elevating device (hereinafter referred to as an "elevating device") 42 for automatically elevating and lowering the ring temple 41. The elevating device 42 corresponds to an automatic temple position switching mechanism.

[0041] The elevating device 42 includes an air cylinder 50 that serves as an actuator, a temple holder 60 to which the ring temple 41 is attached, and a link mechanism 70 that connects the air cylinder 50 and the ring temple 41 to each other. In the elevating device 42, the members 50, 60, and 70 are swingably supported by a pair of support plates 43 that are fixed to a frame of the loom (not shown) or the like. The pair of support plates 43 are disposed so as to face each other in the weaving-width direction with a distance therebetween, and the members 50, 60, and 70 are supported between the pair of support plates 43. Each of the members 50, 60, and 70 will be described below in detail.

[0042] A bracket 51 is rotatably supported by a first support shaft 50A, which extends between the pair of support plates 43, with a bearing 50a (plain bearing or the like). One side of the air cylinder 50 (to be specific, the head cover side of a cylinder body 52) is fixed to the bracket 51. Thus, the air cylinder 50 is rotatably supported by the pair of support plates 43 through the bracket 51. As with the first support shaft 50A, various shafts that will be described below extend in the weaving-width direction.

[0043] A connection member 54 is attached to one end of the cylinder body 52 (an end of a piston rod 53, which protrudes from the rod cover side) of the air cylinder 50. The connection member 54 has a two-forked shape (angular U-shape in plan view) that is open in a direction away from the rod cover. Opposite members 54a, which form the two-forked shape, are separated from each other in the weaving-width direction. A first connection shaft 54B extends between the opposite members 54a.

[0044] The temple holder 60 is a unit (integrally formed member) including a base portion 61, an arm portion 62, and a support portion 63 that are integrally formed with each other. The base portion 61 extends in the weaving-width direction. The arm portion 62 extends in a direction (lateral direction in Fig. 3) that is perpendicular to the longitudinal direction of the base portion 61. The support portion 63 is a block-shaped member formed at an end of the arm portion 62. The ring temple 41 is attached to the base portion 61. A through-hole 63b is formed in the support portion 63 so as to extend in the longitudinal direction of the base portion 61. A second support shaft 63A is inserted through the through-hole 63b with a bearing 63a (plain bearing or the like) therebetween, and the second support shaft 63A extends between the pair of support plates 43. Thus, the temple holder 60 is rotatably supported by the pair of support plates 43 at the support portion 63 thereof.

[0045] The link mechanism 70 includes a first link lever 71 and a second link lever 72. One end of the first link lever 71 (the upper end in Fig. 3) is rotatably supported by a third support shaft 71A that extends between the pair of support plates 43 with a bearing 71a (plain bearing or the like). The other end of the first link lever 71 (the lower end in Fig. 3) is rotatably connected to the first connection shaft 54B of the connection member 54 with a bearing 54b (plain bearing or the like).

[0046] One end of the second link lever 72 (the upper end in Fig. 3) is rotatably connected to the first connection shaft 54B of the connection member 54 with the bearing 54b (plain bearing or the like). The other end of the second link lever 72 (the lower end in Fig. 3) has a two-forked shape as with the connection member 54, and a second connection shaft 72B extends between a pair of opposite members 72a. The other end of the second link lever 72 is connected to a connection piece 73 that is attached to the upper surface of the temple holder 60 through the second connection shaft 72B. A bearing 72b (plain bearing or the like) is disposed between the second connection shaft 72B and the connection piece 73, so that the second connection shaft 72B (second link lever 72) and the connection piece 73 are rotatably connected to each other.

[0047] As described above, the first connection shaft 54B, which connects the first link lever 71 to the second link lever 72, extends across the two-forked connection member 54. A stopper 74, which defines the protruding limit of the piston rod 53 to which the connection member 54 is attached, is disposed between the pair of support plates 43. The stopper 74 is disposed at a position such that, when the piston rod 53 protrudes and the connection member 54 contacts the stopper 74, the third support shaft 71A, the first connection shaft 54B, and the second connection shaft 72B are positioned on the same line in a side view.

[0048] The temple device 40 having the above-described structure is disposed at each end of the loom in the weaving-width direction. A temple bar 81, which extends in the weaving-width direction, is disposed below the temple devices 40 and fixed to the frame (not shown) of the loom. A temple guide 83 and a temple base 84 are attached to the temple bar 81 at positions corresponding to the selvedge in lateral directions using a temple bracket 82 that is fixed to the temple bar 81 with a holder 80. The temple guide 83 and the temple base 84 are disposed below the ring temple 41 at positions in front of and behind the ring temple 41, respectively. The temple guide 83 and the temple base 84, which form a U-shape in side view, guide ends of a fabric.

[0049] In the temple device 40 having the above-described structure, the positions of the first to third support shafts 50A, 63A, and 71A are fixed relative to the support plates 43. The positions of the first and second connection shafts 54B and 72B are movable. In the temple device 40, when the piston rod 53 of the air cylinder 50 has protruded to the limit as illustrated in Fig. 3, the first link lever 71 and the second link lever 72 extend along substantially the same line, and the distance between the third support shaft 71A, which is fixed, and the second connection shaft 72B, which is movable, is the maximum. In this state, the ring temple 41 is positioned at the lower limit of the elevation range, the lower end of the ring temple 41 is positioned below the upper ends of the temple guide 83 and the temple base 84, and the ring temple 41 is in pressed contact with the fabric.

[0050] When the piston rod 53 moves backward from the state illustrated in Fig. 3, as illustrated in Fig. 4, the first link lever 71 rotates around the third support shaft 71A, which is fixed, whereby the first link lever 71 and the second link lever 72 form an angle therebetween. Thus, the distance between the third support shaft 71A, which is fixed, and the second connection shaft 72B, which is movable, decreases and the connection piece 73 is raised, whereby the temple holder 60 rotates upward around the second support shaft 63A, which is fixed. As a result, the ring temple 41 is displaced upward. When the piston rod 53 is at the most retracted position, the ring temple 41 is at the highest position in the elevation range, and the ring temple 41 is separated from the fabric. As the piston rod 53 of the air cylinder 50 reciprocates in such a manner, the ring temple 41 is positioned at one of the lowest position and the highest position in the elevation range.

[0051] Fig. 6 illustrates a control mechanism of the air cylinder 50. The air cylinder 50 causes the piston rod 53 to reciprocate by using compressed air supplied from an air supply source (not shown). The movement direction of the piston rod 53 is switched by supplying compressed air to one of the pressure chambers on the forward movement side (protruding side) and the backward movement side (retracting side) in the cylinder body 52 and discharging compressed air from the other of the pressure chambers. Supply of compressed air to one pressure chamber and discharge of compressed air from the other pressure chamber can be switched by using a four-directional switching valve 90.

[0052] The four-directional switching valve 90 is a solenoid valve. The temple device 40 includes switching control means 93 for controlling the operation of the solenoid valve. The switching control means 93 includes a drive controller 94, which serves as control means, and a storage unit 95, which serves as setting storage means.

[0053] Movement start timing for the ring temple 41 (hereinafter referred to as the "temple 41") is set (stored) in the storage unit 95 by using an input setting unit 96.

The movement start timing for the ring temple 41 is used when the weave section is switched between the tabby section and the tire fabric section (= the timing at which the four-directional switching valve 90 is activated to move the piston rod 53 of the air cylinder 50 forward or backward). The input setting unit 96 includes a display (not shown), an input unit, and the like.

[0054] In the example illustrated in Fig. 6, a set value of the movement start timing as an operation mode of the temple 41 when switching the weave section from the tire fabric section to the tabby section is set as a timing of activating the four-directional switching valve 90 to move the piston rod 53 of the air cylinder 50 forward. The movement start timing is set as a time lag from the time when the weave section is switched from the tire fabric section to the tabby section. The movement start timing is set as a pick number, a time period, or as a weaving length.

[0055] In the example illustrated in the figures, the movement speed of the temple 41 (the speed with which the piston rod 53 of the air cylinder 50 moves forward or backward) is not set because the movement speed is fixed at a particular value in accordance with the setting of the device, such as the pressure of compressed air. However, in the case where an actuator whose speed can be controlled (for example, an electric motor) is used, the movement speed may be set.

[0056] The movement start timing is set as follows. Assuming that, for example, the optimal timing at which the temple 41 engages with the fabric is the time when the boundary between the tire fabric section and the tabby section reaches a position below the lowest point of the temple 41 and the vicinity of the lowest point, the value of the movement start timing is set on the basis of the following operation conditions 1) to 3) of the temple 41 and the following weaving condition 4):

1) the movement speed of the temple 41;
2) the distance that the temple 41 moves from the standby position to a position at which the temple 41 engages with the fabric;
3) the distance between the cloth fell and the position on the fabric at which the temple 41 starts engaging with the fabric when the temple 41 is lowered; and
4) the number of revolutions of the loom and the weft density, which are weaving conditions (that determine the weaving speed (the movement speed of the fabric)).

[0057] These conditions are predetermined. Therefore, an operator calculates a movement start timing that enables the temple 41 to start engaging with the fabric at the optimal timing on the basis of these conditions, and sets the calculated movement start timing in the storage unit 95 by using the input setting unit 96. The method of determining the movement start timing is not limited to the calculation based on the above-described conditions. The optimal timing may be determined by performing test weaving with a plurality of movement start timings. A set value S10 thus determined is output to the drive controller 94.

[0058] At the movement start timing that is set in the storage unit 95, the drive controller 94 operates the four-directional switching valve 90 so as to change the connection state of the channels of compressed air on the supply side and on the discharge side of the four-directional switching valve 90.

[0059] The loom control device 30 includes weaving length monitoring means 31 for monitoring a weaving length of a fabric that is being woven, a main controller 33 for controlling driving of the devices of the loom, and a weaving condition setting unit 32 in which weaving conditions and the like are set.

[0060] The weaving length monitoring means 31 is known means including, for example, a counter that increments the count by one for each rotation of the main shaft 9a of the loom on the basis of a signal S7 supplied from the encoder 9b for detecting the rotation angle of the main shaft 9a (every time the rotation angle 0° (360°) is detected). The weaving length is calculated in accordance with the count, the weft density set in the weaving condition setting unit 32, and the weaving crimp ratio of the fabric that is being woven, which is obtained beforehand. The weaving length monitoring means 31 outputs a signal S8 of the calculated weaving length to the main controller 33.

[0061] The input setting unit 96, which is connected to the storage unit 95 of the switching control means 93, is connected to the weaving condition setting unit 32. Weaving conditions are set in the weaving condition setting unit 32 by using the input setting unit 96. The weaving conditions include the following: the weft density, the number of revolutions of the loom, and a weaving pattern such as the weaving length and the order in which the weave sections (tire fabric section, tabby section) are to be woven.

[0062] The main controller 33 obtains the switching timing of the weaving conditions from a weaving pattern S3, which has been set in the weaving condition setting unit 32, and the weaving length S8, which has been calculated by the weaving length monitoring means 31. When the switching timing arrives, the main controller 33 outputs a signal S4 that represents switching of the weave sections and information regarding the next weave section to be woven to the drive controller 94 of the switching control means 93. Therefore, in the example illustrated in Fig. 6, the main controller 33 has a function of a switching command means.

[0063] The main controller 33 outputs a signal S9 that represents switching of the weave sections to the weaving length monitoring means 31. When the signal S9 is input, the weaving length monitoring means 31 resets the detected weaving length and restarts detection of a weaving length.

[0064] As described above, the main controller 33 outputs the signal S4, which represents switching of the weave sections and information regarding the next weave section to be woven, to the drive controller 94. On the basis of the signal S4, the drive controller 94 determines whether the next weave section to be woven is the tire fabric section or the tabby section. For convenience of description, it is assumed here that the next weave section to be woven is the tabby section. When weaving the tabby section, after a set value of the movement start timing (a time lag), which is set in the storage unit 95, from the switching timing of the weave sections, the drive controller 94 outputs an operation signal S11 to the four-directional switching valve 90 to activate the four-directional switching valve 90 in order to change the connection state of the channels of compressed air on the supply side and the discharge side.

[0065] When the four-directional switching valve 90, which is controlled by the drive controller 94, is in the state illustrated in Fig. 6, the channel for supplying compressed air is connected to the pressure chamber on the backward movement side and the channel for discharging compressed air is connected to the pressure chamber on the forward movement side, so that the piston rod 53 receives a pressure from the compressed air in a backward direction. When the four-directional switching valve 90 is operated in this state and the connections of the channels are switched, the piston rod 53 receives a pressure in the protruding direction and protrudes, so that the compressed air is discharged from the pressure chamber on the backward movement side. As a result, the piston rod 53 moves forward, the link mechanism 70 rotates the temple holder 60 downward, the temple 41 moves downward from the operating position, and finally the temple 41 reaches the operating position. Because the movement start timing of the temple 41 is determined as described above, the temple 41 starts to be engaged with the fabric at an appropriate timing, so that problems described in "SUMMARY OF THE INVENTION" do not occur.

[0066] Modifications of the example illustrated in the figures will be described below. In the example illustrated in the figures, the air cylinder 50 is used as an actuator, which is a drive source. Instead, other types of actuators, such as an electric motor or a rotary solenoid, may be used. For example, an electric motor may be used as an actuator, the second support shaft 63A may be reciprocally rotated using a crank mechanism or the like, and the temple holder 60 may be swung by the rotation of the second support shaft 63A.

[0067] When an electric motor is used as an actuator and the movement of the temple 41 is controlled by controlling driving of the electric motor, not only the movement start timing but also the movement speed are set in the storage unit 95 as an operation mode of the temple 41, and the drive controller 94 controls driving of the electric motor on the basis of the set operation mode.

[0068] In the example illustrated in the figures, the temple holder 60 includes the arm portion 62 and the support portion 63, connects the link mechanism 70 to the base portion 61, and swings the temple 41 using the arm portion 62 and the support portion 63. Instead, the temple 41 may be linearly and vertically moved by attaching the temple holder 60 to an end of the piston rod 53 and disposing the air cylinder 50 above the temple holder 60 such that the piston rod 53 moves vertically (see Japanese Unexamined Patent Application Publication No. 10-298853, Fig. 3). With such a structure, the arm portion 62, the support portion 63, and the link mechanism 70 may be omitted from the temple holder 60.

[0069] In the description above, it is assumed that an operator sets the movement start timing. Instead, the movement start timing may be automatically calculated from a weaving condition or an operating condition of the temple that has been set in the weaving condition setting unit 32. Fig. 7 illustrates the structure of the switching control means 93 in this case. The switching control means 93 includes, in addition to the above-described components, a calculator 98 for calculating the movement start timing. Operating conditions of the temple 41, such as the movement speed of the temple 41 and the movement distance of the temple 41 from the standby position to a position at which the temple starts to engage with the fabric, are stored in the storage unit 95.

[0070] In the example illustrated in the figures, as described above, when a weaving condition is set in the weaving condition setting unit 32 through the input setting unit 96, the weaving condition setting unit 32 outputs the weft density and the number of revolutions, which are included in the weaving conditions, to the calculator 98. Then, the calculator 98 reads an operation condition S23 of the temple 41, which is stored in the storage unit 95, and calculates a movement start timing S24 on the basis of these values. The calculated movement start timing S24 is output to the storage unit 95 and set (stored) in the storage unit 95. In this example, the combination of the storage unit 95 and the calculator 98 corresponds to setting storage means.

[0071] In the example illustrated in the figures, the temple device 40 is of an upper-mount type and the temple 41 is pressed against the fabric from above. However, this is not limited thereto, and the temple 41 may be a lower-mount type and the temple 41 may be pressed against the fabric from below. The present invention is also applicable to the temple device 40 of such a lower-mount type. If the temple device 40 is of a lower-mount type, when displacing the temple 41 toward the standby position, the temple 41 is moved downward, instead of upward as in the example illustrated in the figures.

[0072] In the description above, the loom to which the present invention is applied is a tire cord loom. However, the loom to which the present invention is applied is not limited thereto. The present invention is applicable to any loom for weaving a fabric including two or more weave sections having different densities, the loom including a temple device having an automatic temple position switching mechanism that automatically switches the position of a temple between an operating position and a standby position in accordance with the weft density of the weave section to be woven.

Claims

1. A method of driving a temple (41) of a temple device (40) including an automatic temple position switching mechanism (42), the temple device (40) being used for a loom that weaves a fabric (2a) having two or more weave sections with different weft densities, the temple (41) being displaceable between two positions that are an operating position and a standby position, the automatic temple position switching mechanism (42) automatically switching a position of the temple (41) between the two positions in accordance with a density of the fabric (2a) to be woven, the method being performed when displacing the temple (41) from the standby position toward the operating position in accordance with switching between the weave sections, the method comprising:

   storing an operation mode related to movement of the temple (41) beforehand; and
   controlling the movement of the temple (41) in accordance with the stored operation mode in accordance with switching between the weave sections.

2. The method according to Claim 1, wherein the operation mode is determined on the basis of a weaving condition.

3. The method according to Claim 1, wherein the operation mode is automatically calculated on the basis of a weaving condition that has been set in the loom.

4. A temple device (40) for a loom, the temple device (40) including a temple (41) and an automatic temple position switching mechanism (42), the temple device (40) being used for the loom that successively weaves a fabric (2a) having two or more weave sections with different weft densities in accordance with a set weaving length that has been set beforehand for each of the weave sections while monitoring a weaving length of each of the weave sections, the loom including switching command means (33) that outputs a command signal for instructing switching between the weave sections when the weaving length of the weave section that is being woven reaches the set weaving length, the temple (41) being displaceable between two positions that are an operating position and a standby position, the automatic temple position switching mechanism (42) automatically switching a position of the temple (41) between the two positions in accordance with a density of a fabric (2a) to be woven by using an actuator (50) as a driving source, the temple device (40) comprising:

   setting storage means (95) that stores an operation mode related to movement of the temple (41) beforehand; and
   control means (93) that controls driving of the actuator (50) of the automatic temple position switching mechanism (42) on the basis of the command signal from the switching command means (33) and the operation mode stored in the setting storage means (95).

5. The temple device (40) according to Claim 4, wherein the setting storage means (95) includes a calculator (98) that calculates a movement start timing and/or a movement speed of the temple (41) on the basis of a weaving condition set in the loom.

FIG. 1

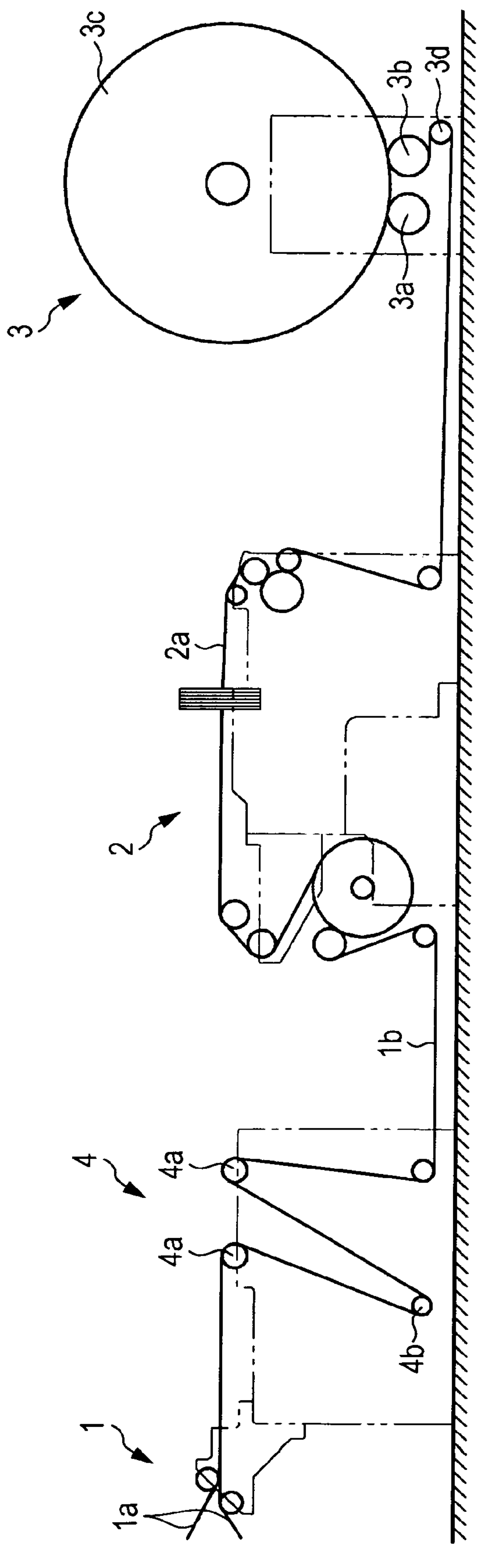
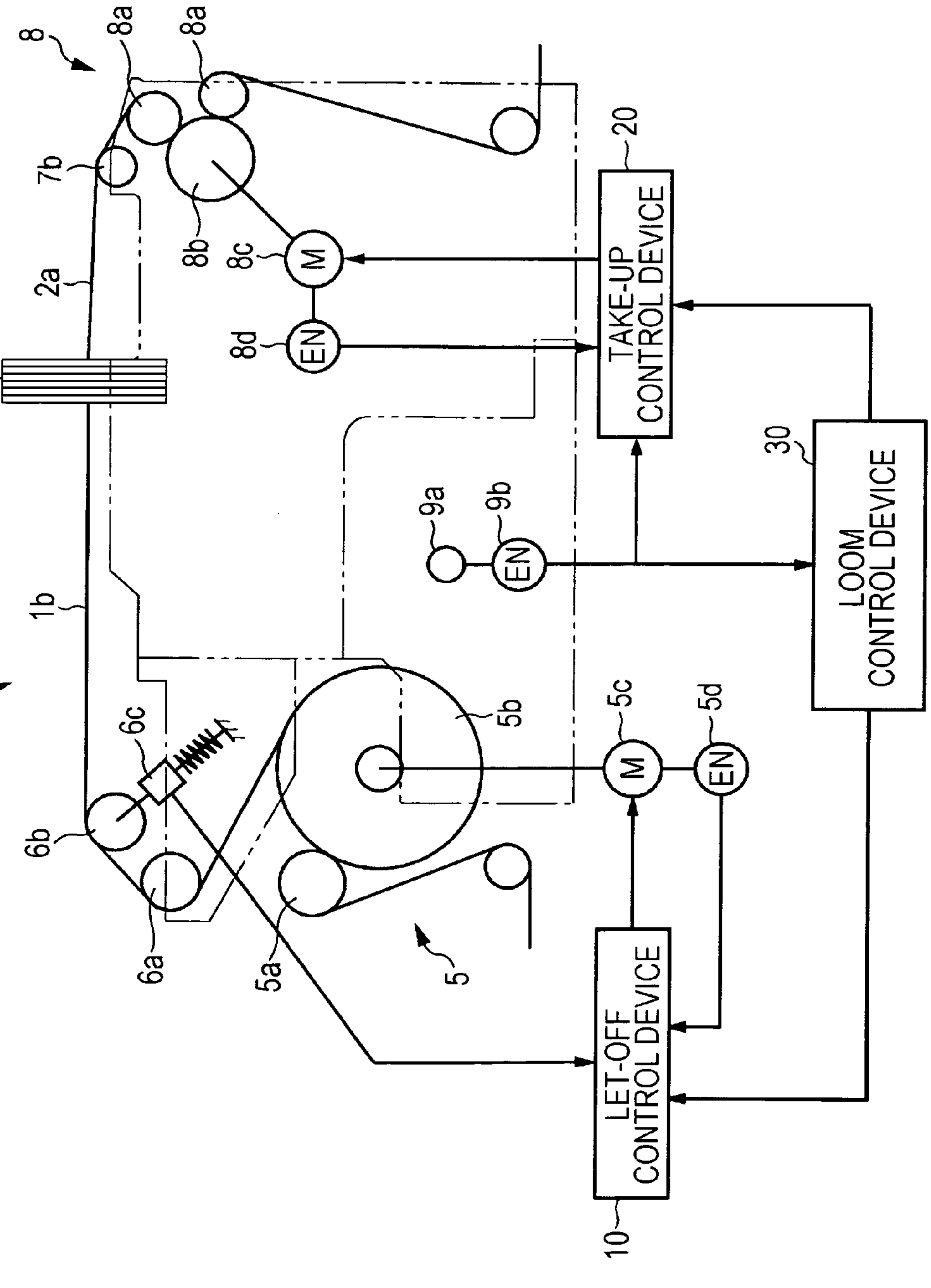


FIG. 2



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LOOM CONTROL DEVICE
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LET-OFF CONTROL DEVICE
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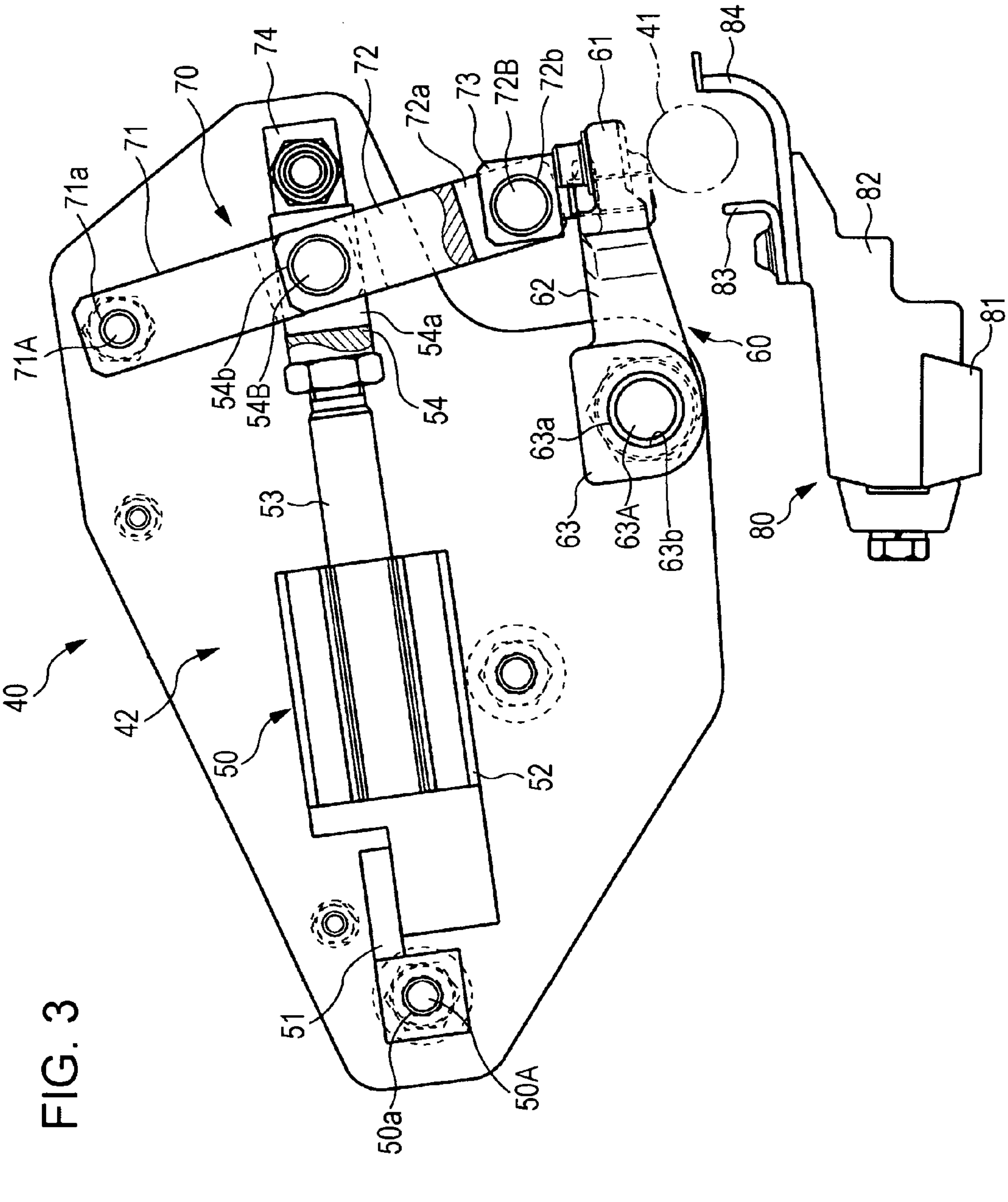
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FIG. 3

FIG. 4

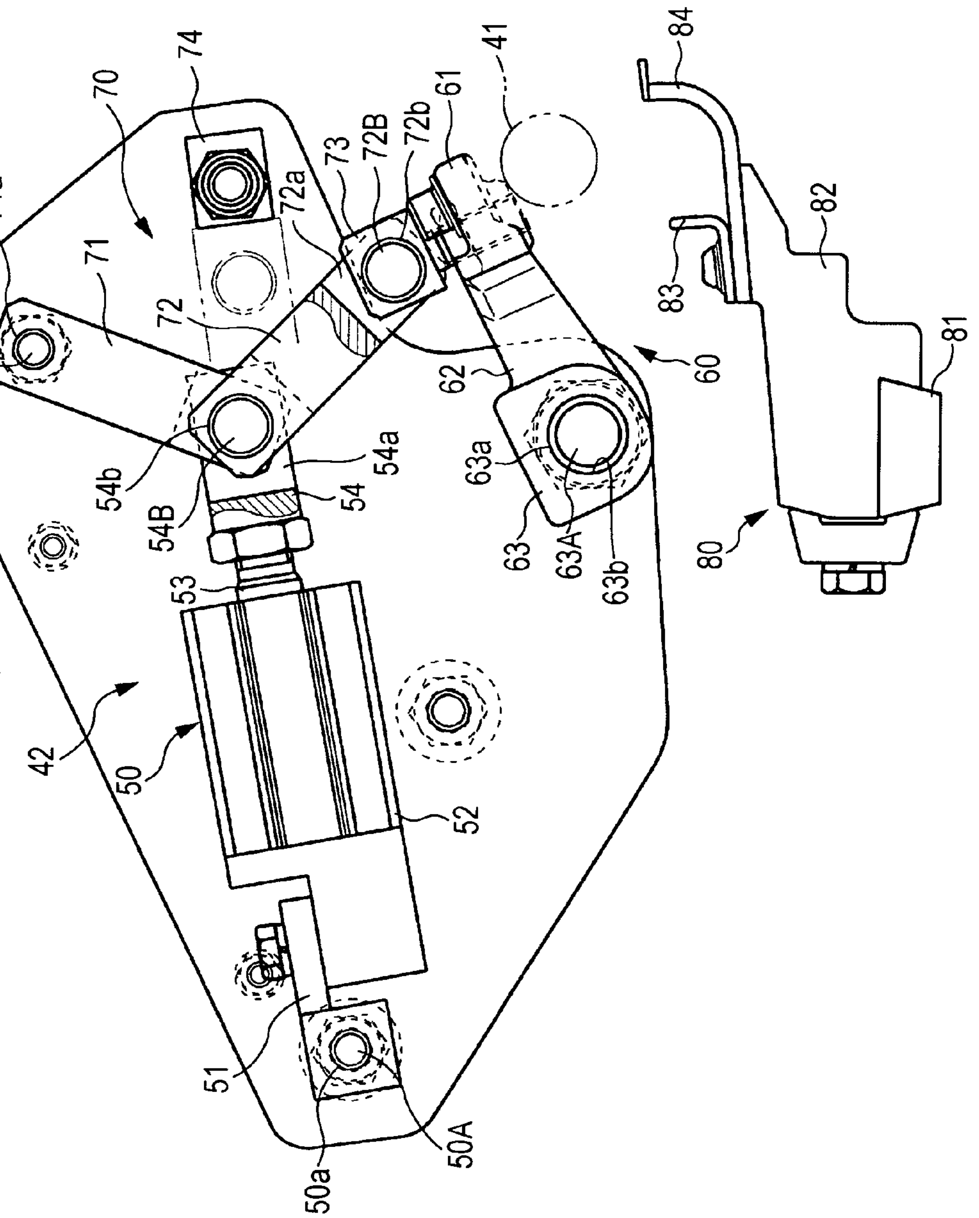
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FIG. 5

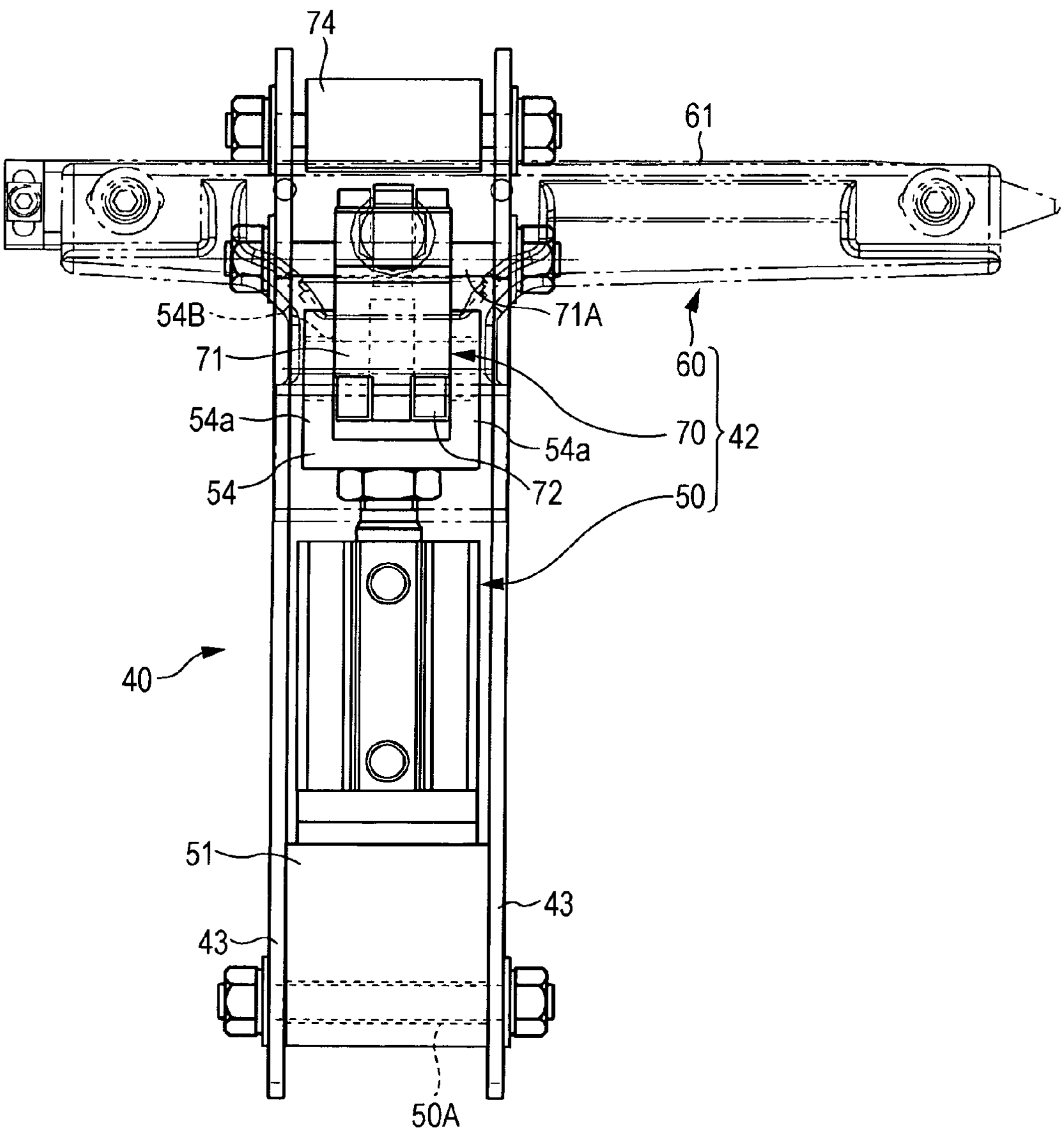
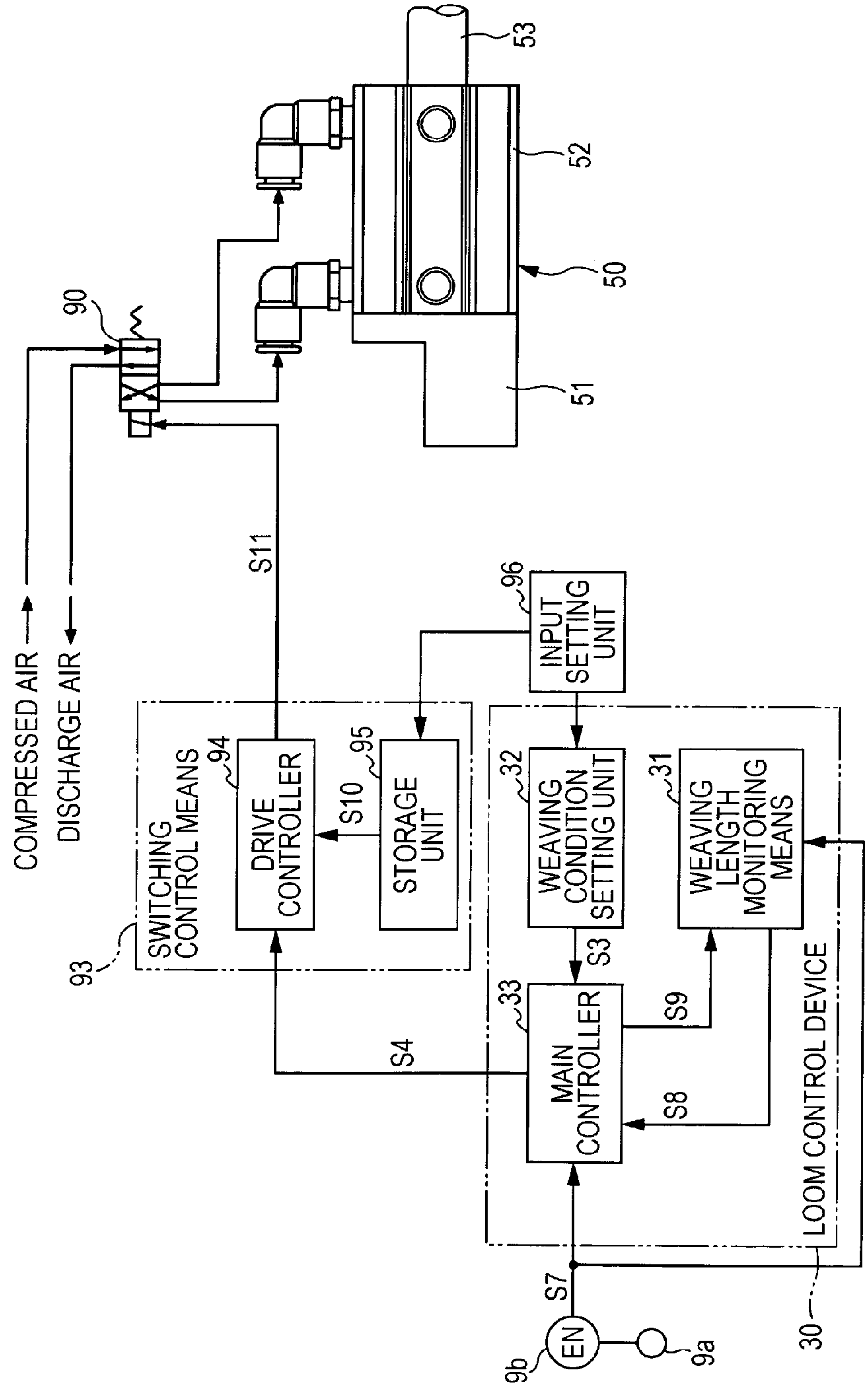


FIG. 6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DISCHARGE AIR
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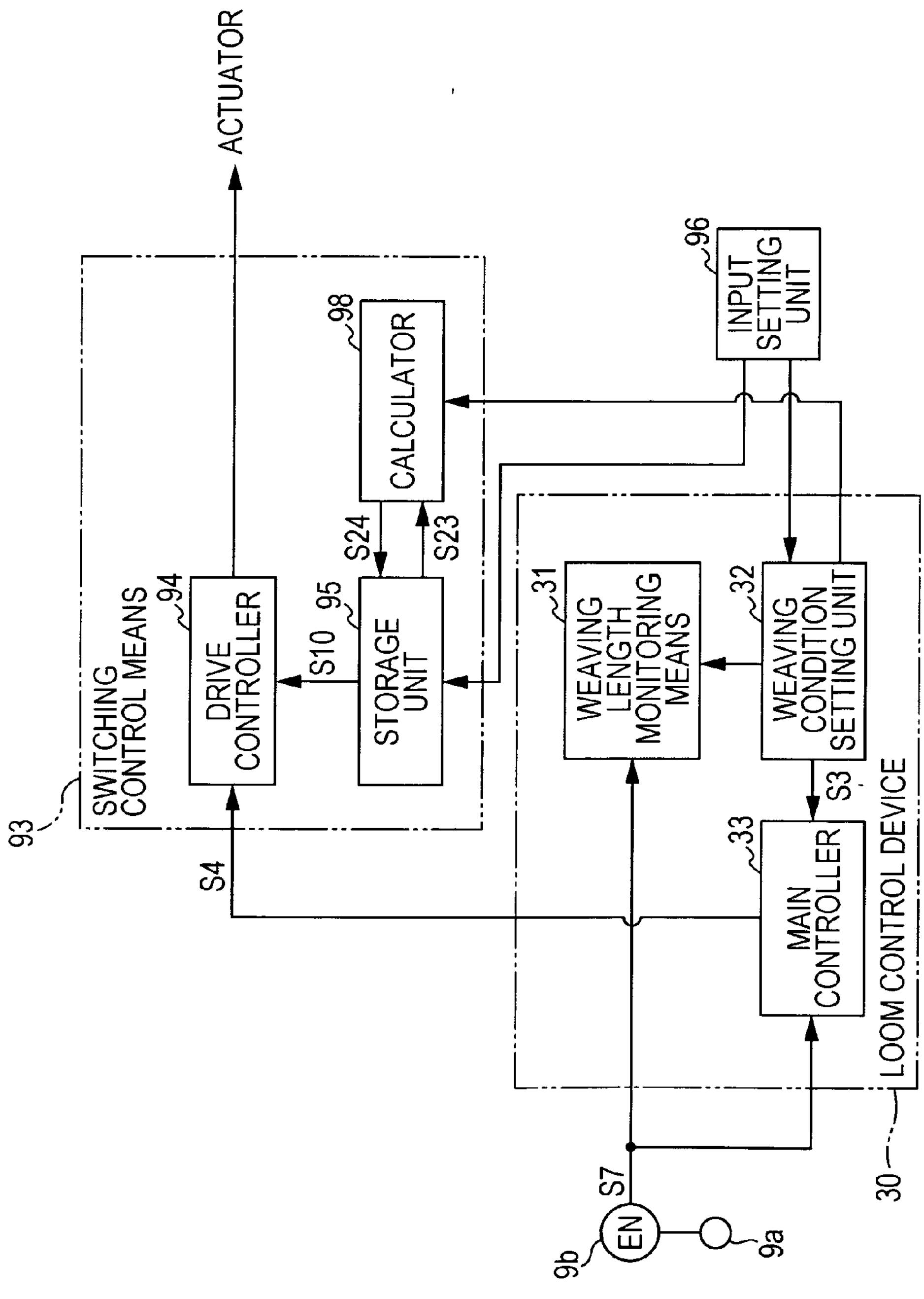
STORAGE UNIT
96
INPUT SETTING UNIT
32
WEAVING CONDITION SETTING UNIT
31
WEAVING LENGTH MONITORING MEANS
S3
33
MAIN CONTROLLER
S4
S9
S8
LOOM CONTROL DEVICE
S7
EN
9b
9a
30

FIG. 7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CALCULATOR
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32
WEAVING CONDITION SETTING UNIT
S3
33
MAIN CONTROLLER
LOOM CONTROL DEVICE
30
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9b
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4281041 A **[0004] [0005] [0008]**
- JP 10298853 A **[0068]**