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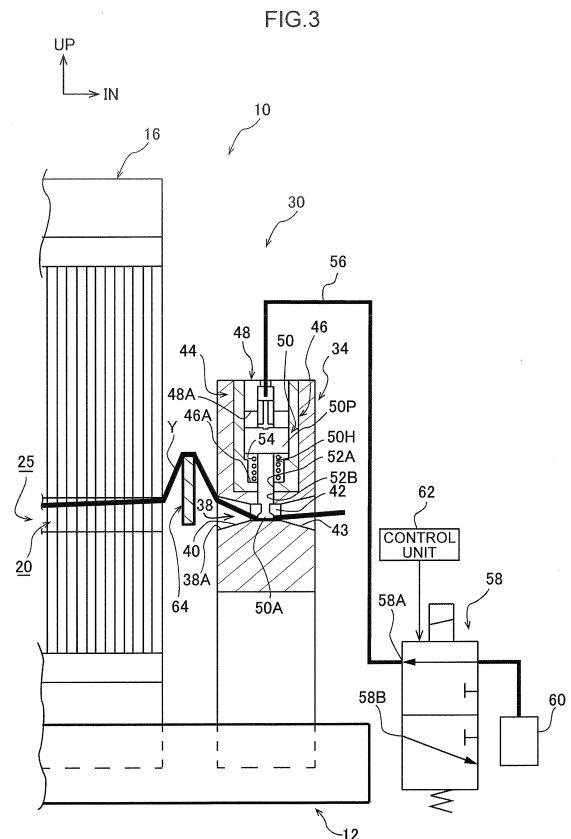
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(54) **WEFT TENSIONING DEVICE**

(57) Provided is a weft tensioning device capable of applying the appropriate tension to a weft while limiting the amount of air consumption. A weft-gripping mechanism part (32) is arranged on the downstream side in the picking direction of a weft (Y) with respect to a picking passage (20) of a modified reed (16). In the weft-gripping mechanism part (32), the tip portion of the picked weft (Y) is inserted through an insertion passage (38), a weft-gripping pin (50) is capable of holding the tip portion of the weft (Y) together with an inner surface of the insertion passage (38), and an air cylinder mechanism (44) actuates the weft-gripping pin (50) to make it hold the tip portion of the weft (Y). Opposite thereto, a tensioning arm (64) is: fixed to a loom frame (26); comes into contact with the weft (Y) between the modified reed (16) and the weft-gripping mechanism part (32) when the tip portion of the weft (Y) is gripped by the gripping mechanism part (32) and the tensioning arm (64) swings in the beating direction of the modified reed (16); and applies pressure to the weft (Y) due to the relative displacement of the tensioning arm (64) with respect to the modified reed (16).



Description

TECHNICAL FIELD

[0001] The present invention relates to a weft tensioning device that applies tension to a picked weft.

BACKGROUND ART

[0002] Weft tensioning devices include a device that, in order to apply the appropriate tension to a weft, blows air from a stretch nozzle into, for example, a weft trapping pipe to catch the weft (for example, see Japanese Patent Application Laid-Open (JP-A) No. 10-204751). In this device, an air ejection from the stretch nozzle begins before a tip portion of the weft reaches a weft introductory recess at the opening side of the weft trapping pipe, and stops just before beating.

DISCLOSURE OF INVENTION

TECHNICAL PROBLEM

[0003] However, in this device, because the air ejection continues from before the tip portion of the weft reaches the weft introductory recess until just before the beating, air consumption is increased and electric power consumption is increased.

[0004] In consideration of the circumstances described above, an object of the present invention is to provide a weft tensioning device that may apply the appropriate tension to a weft while suppressing an amount of air consumption.

SOLUTION TO PROBLEM

[0005] A weft tensioning device relating to a first aspect of the present invention includes: a weft-gripping mechanism part that is arranged at the downstream side in a picking direction of a weft relative to a picking passage of a modified reed and that is fixed on a sley, the weft-gripping mechanism part including an insertion passage that is formed with a periphery being enclosed by a wall surface and into which a tip portion of the picked weft is inserted, a pressing member that is capable of gripping the tip portion of the weft against an inner surface of the insertion passage, and an air cylinder mechanism that actuates the pressing member and causes the pressing member to grip the tip portion of the weft; and a tensioning member that is fixed to a loom frame, comes into contact with the weft between the modified reed and the weft-gripping mechanism part when the modified reed is swinging in a beating direction in the state in which the tip portion of the weft is gripped by the weft-gripping mechanism part, and applies tension to the weft by relative displacement with respect to the modified reed.

[0006] According to the weft tensioning device relating to the first aspect of the present invention, the weft-grip-

ping mechanism part is arranged at the downstream side in the picking direction with respect to the picking passage of the modified reed, and is fixed on the sley. At this weft-gripping mechanism part, an insertion passage whose periphery is enclosed by a wall surface is formed, and the tip portion of the picked weft is inserted into the insertion passage. The pressing member is capable of gripping the tip portion of the weft against the inner surface of the insertion passage. The air cylinder mechanism actuates the pressing member and causes the pressing member to grip the tip portion of the weft. Meanwhile, the tensioning member is fixed to the loom frame. The tensioning member comes into contact with the weft between the modified reed and the weft-gripping mechanism part when the modified reed swings in the beating direction in the state in which the tip portion of the weft is gripped by the weft-gripping mechanism part, and applies tension to the weft by relative displacement with respect to the modified reed. Therefore, air is only consumed when the weft is being gripped.

[0007] In a second aspect of the present invention, in the weft tensioning device relating to the first aspect, the insertion passage is specified such that an opening area of an entry portion thereof is equal to or greater than a passage cross-sectional area of the picking passage of the modified reed, and the insertion passage is formed such that a passage cross-sectional area thereof progressively decreases from the entry portion side toward the side of a region at which the tip portion of the weft is gripped.

[0008] According to the weft tensioning device relating to the second aspect of the present invention, because the opening area of the entry portion of the insertion passage is specified to be equal to or greater than the passage cross-sectional area of the picking passage of the modified reed, the tip portion of the weft may smoothly enter into the insertion passage from the picking passage of the modified reed. Moreover, because the insertion passage is formed such that the passage cross-sectional area progressively becomes smaller from the entry portion side toward the side of the region at which the tip portion of the weft is gripped, the tip portion of the weft may smoothly enter into the insertion passage toward the region at which the weft is gripped, and an operation stroke of the pressing member may be limited.

[0009] In a third aspect of the present invention, in the weft tensioning device relating to the first aspect or the second aspect, the tensioning member protrudes from a fell side in a direction toward a space between the modified reed and the weft-gripping mechanism part, and the tensioning member includes a guide portion that makes contact with the weft when the modified reed is swinging in the beating direction and guides a contacting portion of the weft in an up-and-down direction relative to a height position of the picking passage of the modified reed.

[0010] According to the weft tensioning device relating to the third aspect of the present invention, the guide portion of the tensioning member comes into contact with

the weft when the modified reed is swinging in the beating direction and guides the contacting portion of the weft in the up-and-down direction with respect to the height position of the picking passage of the modified reed. Consequently, the weft is stretched and tension is applied to the weft. Here, because the tensioning member protrudes in the direction toward the space between the modified reed and the weft-gripping mechanism part from the fell side, when the modified reed is swinging and the tip portion of the weft is inserted into the insertion passage of the weft-gripping mechanism part (that is, before the weft comes into contact with the guide portion of the tensioning member and the tip portion of the weft is gripped by the weft-gripping mechanism part), the airflow for the picking flows into the insertion passage of the weft-gripping mechanism part without being obstructed by (conflicting with) the tensioning member that is separated to the fell side. Therefore, even though the tensioning member is arranged for tensioning of the weft, smooth insertion is possible.

[0011] In a fourth aspect of the present invention, in the weft tensioning device relating to the third aspect, the tensioning member includes a circular arc portion that is continuous with the guide portion and provided at the fell side thereof, and that is formed in a circular arc shape along the direction of swinging of the modified reed.

[0012] According to the weft tensioning device relating to the fourth aspect of the present invention, the arc-shaped portion of the tensioning member is continuous with the guide portion, is disposed at the fell side thereof, and is formed in a circular arc shape along the swinging direction of the modified reed. Therefore, in the state in which the weft is in contact with the arc-shaped portion, a stretching amount of the weft is kept constant even while the position changes due to the swinging of the modified reed.

[0013] In a fifth aspect of the present invention, in the weft tensioning device relating to any one of the first to fourth aspects, a width dimension of a distal end portion of the pressing member as viewed in the insertion direction of the insertion passage is specified to be larger than a minimum width dimension of the insertion passage.

[0014] According to the weft tensioning device relating to the fifth aspect of the present invention, because the width dimension of the tip portion of the pressing member as viewed in the insertion direction of the insertion passage is specified to be larger than the minimum dimension of the insertion passage, the weft may be more reliably gripped in the insertion passage.

[0015] In a sixth aspect of the present invention, in the weft tensioning device relating to any one of the first to fifth aspects, a small diameter portion is formed at the pressing member, the small diameter portion being continuous with a distal end portion of the pressing member and having a smaller diameter than the distal end portion, and the pressing member being specified such that at least a portion of the small diameter portion is disposed inside the insertion passage in the state in which the tip

portion of the weft is gripped between the pressing member and the inner surface of the insertion passage.

[0016] According to the weft tensioning device relating to the sixth aspect of the present invention, the small diameter portion of the pressing member is continuous with the tip portion of the pressing member and is specified to be smaller in diameter than the tip portion, and in the state in which the pressing member grips the tip portion of the weft against the inner surface of the insertion passage, at least a portion of the small diameter portion of the pressing member is disposed inside the insertion passage. Therefore, in the weft gripping state, a gap is formed between the small diameter portion and the insertion passage. As a result, even when the airflow causing picking enters in the weft gripping state, occurrences of reverse flow may be suppressed, and the weft gripping state is more stable.

[0017] In a seventh aspect of the present invention, in the weft tensioning device relating to any one of the first to sixth aspects, the tensioning member is plurally provided in a row along the picking direction of the weft, each tensioning member coming into contact with the weft when the modified reed is swinging in the beating direction and guiding a contacting portion of the weft in the up-and-down direction relative to the height position of the picking passage of the modified reed, and the guiding direction being specified to be vertically opposite to the guiding direction of each neighboring other tensioning member.

[0018] According to the weft tensioning device relating to the seventh aspect of the present invention, the tensioning member is provided plurally in a row along the picking direction of the weft. Each tensioning member comes into contact with the weft when the modified reed is swinging in the beating direction, guides a contacting portion of the weft in the up-and-down direction with respect to the height position of the picking passage of the modified reed, and is specified such that the guide direction is in the opposite direction, up or down, to that of a neighboring tensioning member. Therefore, a stretching amount of the weft may easily be set to be larger.

[0019] In an eighth aspect of the present invention, in the weft tensioning device relating to any one of the first to seventh aspects, an air passage portion is formed for ejecting exhaust air that has been supplied to and used at the air cylinder mechanism from an ejection aperture, the ejection aperture being disposed adjacent to the weft picking direction downstream side of the picking passage of the modified reed and the ejection aperture being disposed to oppose a detection surface of a weft detection sensor that is for detection of the weft.

[0020] According to the weft tensioning device relating to the eighth aspect of the present invention, the ejection aperture is provided adjacent to the weft picking direction downstream side of the picking passage of the modified reed, and is arranged to oppose the detection surface of the weft detection sensor that is for detection of the weft. Exhaust air that has been supplied to and used at the air

cylinder mechanism passes through the air passage portion and is ejected from the ejection aperture toward the weft detection sensor. Thus, the weft detection sensor is cleaned and reliability of the weft detection sensor can be assured.

[0021] In a ninth aspect of the present invention, in the weft tensioning device relating to any one of the first to eighth aspects, a movement mechanism is provided at the loom frame, the movement mechanism moving the tensioning member in the up-and-down direction and a horizontal direction orthogonal to the picking direction of the weft by motor driving.

[0022] According to the weft tensioning device relating to the ninth aspect of the present invention, the movement mechanism that moves the tensioning member in the up-and-down direction and in the horizontal direction that is orthogonal to the picking direction of the weft by driving with a motor is provided at the loom frame. Therefore, setting a position of the tensioning member in accordance with types of weft and picking conditions and the like becomes easy.

[0023] In a tenth aspect of the present invention, in the weft tensioning device relating to any one of the first to ninth aspects, a relationship between a passage cross-sectional area S_b of the region of the insertion passage at which the tip portion of the weft is gripped between the insertion passage and the pressing member and a passage cross-sectional area S_a of the picking passage of the modified reed is specified such that $0.2S_a \leq S_b \leq 0.7S_a$.

[0024] According to the weft tensioning device relating to the tenth aspect of the present invention, the relationship between the passage cross-sectional area S_b of the region of the insertion passage at which the tip portion of the weft is gripped by the pressing member and the passage cross-sectional area S_a of the picking passage of the modified reed is set to $0.2S_a \leq S_b \leq 0.7S_a$. Therefore, ease of entry of the weft into the insertion passage when the weft is being inserted in the direction toward the gripping position is assured and, because the stroke of the pressing member is short, responsiveness is excellent.

ADVANTAGEOUS EFFECTS OF INVENTION

[0025] As described hereabove, according to the weft tensioning member relating to the present invention, there is an excellent effect in that an appropriate tension may be applied to a weft while an amount of air consumption is suppressed.

BRIEF DESCRIPTION OF DRAWINGS

[0026]

Fig. 1 is a perspective view showing a weft tensioning device in accordance with a first exemplary embodiment of the present invention, in a state when picking

is complete.

Fig. 2 is a perspective view showing the weft tensioning device in accordance with the first exemplary embodiment of the present invention, in a state in which the weft is being tensioned.

Fig. 3 is a vertical sectional diagram in a front elevation, showing principal portions of the weft tensioning device in accordance with the first exemplary embodiment of the present invention.

Fig. 4A is an exploded perspective diagram showing a lower portion of a weft-gripping pin and a weft-gripping passage of the weft tensioning device in accordance with the first exemplary embodiment of the present invention.

Fig. 4B is a vertical sectional diagram showing the lower portion of the weft-gripping pin and the weft-gripping passage of the weft tensioning device in accordance with the first exemplary embodiment of the present invention, in which a state in which the weft is gripped is viewed in an insertion direction of an insertion passage.

Fig. 5 is a vertical sectional diagram in a front elevation, showing principal portions of a weft tensioning device in accordance with a second exemplary embodiment of the present invention, in the state in which the weft is being tensioned.

Fig. 6 is a perspective view showing a state of arrangement of tensioning arms of a weft tensioning device in accordance with a second exemplary embodiment of the present invention.

Fig. 7 is a vertical sectional diagram in a front elevation, showing principal portions of a weft tensioning device in accordance with a third exemplary embodiment of the present invention, in the state in which the weft is being tensioned.

Fig. 8 is a plan diagram showing principal portions of a weft tensioning device in accordance with a fourth exemplary embodiment of the present invention.

Fig. 9 is an operation diagram in a side elevation, for describing the operation of a weft tensioning device in accordance with a fifth exemplary embodiment of the present invention.

Fig. 10 is an operation diagram in a side elevation, for describing the operation of a weft tensioning device in accordance with a sixth exemplary embodiment of the present invention.

Fig. 11 is a vertical sectional diagram in a side elevation, showing principal portions of a weft tensioning device in accordance with a seventh exemplary embodiment of the present invention.

Fig. 12 is a side view showing principal portions of a weft tensioning device in accordance with an eighth exemplary embodiment of the present invention.

Fig. 13 is a graph showing the relationship between a passage cross-sectional area ratio and the response time of a weft-gripping pin.

Fig. 14 is a graph showing the relationship between

the passage cross-sectional area ratio and ease of entry of a weft into a weft-gripping passage.

Fig. 15A is a diagram for explaining the cross-sectional area ratio in Fig. 13 and Fig. 14, showing the passage cross-sectional area of a picking passage of a modified reed.

Fig. 15B is a diagram for explaining the cross-sectional area ratio in Fig. 13 and Fig. 14, showing the passage cross-sectional area of the weft-gripping passage.

Fig. 16 is a perspective view showing a weft tensioning device in accordance with a ninth exemplary embodiment of the present invention, in the state when picking is complete.

Fig. 17 is a perspective view showing the weft tensioning device in accordance with the ninth exemplary embodiment of the present invention, in the state in which the weft is being tensioned.

Fig. 18 is a vertical sectional diagram in a front elevation, showing principal portions of the weft tensioning device in accordance with the ninth exemplary embodiment of the present invention.

Fig. 19 is a vertical sectional diagram in a side elevation showing the weft tensioning device in accordance with the ninth exemplary embodiment of the present invention, in a section cut at a position of a weft-gripping passage.

Fig. 20 is a vertical sectional diagram in a side elevation showing the weft tensioning device in accordance with the ninth exemplary embodiment of the present invention, in a section cut at a position close to a position of arrangement of a tensioning arm.

Fig. 21 is a front view showing a pin-retaining part of the weft tensioning device in accordance with the ninth exemplary embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

- First Exemplary Embodiment -

[0027] A weft tensioning device in accordance with a first exemplary embodiment of the present invention is described using Fig. 1 to Fig. 4B. In these drawings, the arrow FR that is shown where appropriate indicates the fell side of a loom, the arrow UP indicates an upward side of the loom, and the arrow IN indicates a picking direction of a weft.

[0028] Fig. 1 shows a perspective view of a state in which a weft tensioning device 30 is installed at a loom 10 (only a portion of which is shown in the drawings). As shown in Fig. 1, the loom 10 is equipped with a sley 12 that extends in a left-and-right direction in a front elevation. The sley 12 is formed to be capable of swinging (see the direction of arrow A) about an axis in the left-and-right direction of the loom 10. A slot portion 12A is formed in an upper face side of the sley 12 along the length direction thereof. A lower end portion of a modified reed

16 is fastened and fixed in the slot portion 12A of the sley 12 by a wedge member 14. That is, the modified reed 16 is fixed standing up from the sley 12, and can be swung together with the sley 12.

[0029] The modified reed 16 is equipped with a plural number of reed dents 18, whose length directions are in the direction of standing of the modified reed 16. The reed dents 18 are arranged in a row in the left-and-right direction of the loom 10. Recess-form guide holes 18A that open to the fell side of the loom 10 are formed in the reed dents 18. The guide holes 18A form a picking passage 20 through the loom 10 in the left-and-right direction. The picking passage 20 is a passage along which a weft Y flies due to a relay ejection operation of plural sub-nozzles 22 for picking (only one of which is shown in the drawings). The weft Y is injected and supplied (ejected) from a main nozzle for picking, which is not shown in the drawings, that is at the left side of the loom 10 in front elevation.

[0030] The weft Y is drawn out from a winding portion in a weft storage device, which is not shown in the drawings, at the left side in the front elevation of the loom 10. After being injected and supplied, the weft Y is stopped by a weft engaging pin, which is not shown in the drawings, at a yarn supply side (the left side in Fig. 1). Thus, supply amounts of the weft Y (lengths of the weft Y) when being picked are constant.

[0031] A weft detection sensor 24 (a weft detector) for detection of the weft Y is disposed at a front face side of the modified reed 16, adjacent to the picking passage 20 of the modified reed 16 at the downstream side of the picking direction of the weft Y. The weft detection sensor 24 is fixed standing from the front face side of the sley 12, and is disposed between a warp yarn T1 for forming a woven fabric W1 and a selvage yarn T2 for forming a selvage W2. The weft detection sensor 24 is oriented toward the picking passage 20 and has a detection region in the picking passage 20. The weft detection sensor 24 detects whether or not the weft Y has traversed the interior of the picking passage 20. The weft detection sensor 24 is connected to a control unit 62 (which is shown as a block in the drawings), and outputs detection results to the control unit 62.

[0032] A weft-gripping block 34 of a weft-gripping mechanism part 32 is disposed at the weft Y picking direction downstream side relative to the picking passage 20 of the modified reed 16. The weft-gripping block 34 is placed slightly apart from the modified reed 16. The weft-gripping block 34 of the weft-gripping mechanism part 32 is fixed on the sley 12. The weft-gripping mechanism part 32 constitutes a portion of the weft tensioning device 30. An insertion passage 38, into which a tip portion of the weft Y that has been picked is inserted, is formed so as to penetrate through the weft-gripping block 34.

[0033] The insertion passage 38 is formed with a periphery thereof enclosed by a wall surface. An opening area of an entry portion 38A of the insertion passage 38 is specified to be equal to or greater than a passage

cross-sectional area of the picking passage 20 of the modified reed 16 (as an example in the present exemplary embodiment, about 20% larger). A weft introduction passage 40 is formed at the insertion passage 38 such that the passage cross-sectional area thereof progressively decreases (constricts) from the entry portion 38A side toward a region at which the tip portion of the weft Y is gripped (which is described in detail below). As shown in Fig. 3, a weft-gripping passage 42 is formed in the insertion passage 38. The weft-gripping passage 42 is continuous with the tapered weft introduction passage 40 and is formed in a rectangular shape in the sectional view of Fig. 3.

[0034] A release passage 43 at the downstream side of the weft-gripping passage 42 is formed as a widening taper, which is a shape whose passage cross-sectional area progressively increases. The weft introduction passage 40, weft-gripping passage 42 and release passage 43 are disposed on a line of extension of the picking passage 20 of the modified reed 16 and, together with the picking passage 20 of the modified reed 16, constitute a weft guiding passage 25.

[0035] An air cylinder mechanism 44 is disposed at an upper portion of the weft-gripping block 34. A cylinder 46 of the air cylinder mechanism 44 has a hollow interior, and a stopper 48 is pushed into an upper opening portion of the cylinder 46. A weft-gripping pin 50, which serves as a pressing member, is disposed inside the cylinder 46.

[0036] The weft-gripping pin 50 is a structure in which a short circular column-shaped piston portion 50P is coaxially and integrally provided at one axial direction end portion (the upper end portion in the present exemplary embodiment) of a pin main body 50H in a substantially circular rod shape with a small diameter. The interior cavity of the cylinder 46 is divided into two chambers by the piston portion 50P. A distal end portion 50A side of the pin main body 50H of the weft-gripping pin 50 penetrates through a floor wall portion 46A of the cylinder 46 and a portion of the weft-gripping block 34 and is disposed in the weft-gripping passage 42. A communication hole 52A that is formed at an axial center portion of the floor wall portion 46A and through which the distal end portion 50A side of the pin main body 50H penetrates is formed with a larger diameter than the pin main body 50H. A communication hole 52B, which communicates with the communication hole 52A and the weft-gripping passage 42, is formed in the weft-gripping block 34 coaxially and with the same diameter as the communication hole 52A. Thus, a structure is formed in which axial direction movements of the weft-gripping pin 50 (movements in the up-and-down direction orthogonal to the weft-gripping passage 42 in the present exemplary embodiment) in states in which pressure is applied by air are possible. That is, the weft-gripping pin 50 is capable of gripping the tip portion of the weft Y against the inner surface (inner wall face) of the weft-gripping passage 42 (the insertion passage 38). The air cylinder mechanism 44 actuates the weft-gripping pin 50 to make the weft-gripping pin 50 grip

the tip portion of the weft Y.

[0037] The passage cross-sectional area of the insertion passage 38 at the region at which the tip portion of the weft Y is gripped by the weft-gripping pin 50 is a passage cross-sectional area S_b , and the passage cross-sectional area of the picking passage 20 of the modified reed 16 is a passage cross-sectional area S_a . It is preferable if the relationship between the passage cross-sectional area S_b and the passage cross-sectional area S_a is set such that $0.2S_a \leq S_b \leq 0.7S_a$. In the present exemplary embodiment, the passage cross-sectional area S_b of the weft-gripping passage 42 is approximately 30% of the passage cross-sectional area S_a of the picking passage 20.

[0038] Fig. 4A and Fig. 4B show a lower portion of the weft-gripping pin 50 and the weft-gripping passage 42. As shown in Fig. 4A and Fig. 4B, a width dimension 50W of the distal end portion 50A of the weft-gripping pin 50 as viewed in the insertion direction of the insertion passage 38 is specified to be larger than a width dimension (38W) of the insertion passage 38 at portions in front of and behind, in the insertion direction, the region at which the tip portion of the weft Y is gripped. In other words, the width dimension 50W of the distal end portion 50A of the weft-gripping pin 50 as viewed in the insertion direction of the insertion passage 38 is set to be greater than the minimum width dimension 38W of the insertion passage 38.

[0039] A small diameter portion 50B is formed at the weft-gripping pin 50. The small diameter portion 50B is continuous with the distal end portion 50A and has a smaller diameter than the distal end portion 50A. The weft-gripping pin 50 is specified such that, in the state in which the weft-gripping pin 50 grips the tip portion of the weft Y against the inner surface (inner wall face) of the weft-gripping passage 42 (the insertion passage 38), at least a portion of the small diameter portion 50B is disposed inside the weft-gripping passage 42 (the insertion passage 38).

[0040] As shown in Fig. 3, a compression coil spring 54 (a return spring, which is an element that can be understood in a broader sense as an urging member) is wound round the outer periphery side of the weft-gripping pin 50, between the floor wall portion 46A of the cylinder 46 and the piston portion 50P. One end portion of the compression coil spring 54 (the lower end portion) abuts against and is anchored at the floor wall portion 46A of the cylinder 46, and the other end portion (the upper end portion) abuts against and is anchored at an end face (a bottom face) of the piston portion 50P. Therefore, the compression coil spring 54 continuously presses and urges the piston portion 50P in the direction away from the floor wall portion 46A (the upward direction in Fig. 3), and is capable of pushing the piston portion 50P against a stopper surface 48A of the stopper 48. Thus, when there is no pressure from the upper side on the piston portion 50P, the weft-gripping pin 50 is maintained at a position (a non-gripping position, which is not shown in

the drawings) at which the tip portion of the weft Y cannot be gripped against the inner surface of the weft-gripping passage 42 (the insertion passage 38).

[0041] One end portion of a pipe-form air tube 56 is connected to the upper end of the weft-gripping block 34. The air tube 56 is for supplying air into the upper chamber of the interior cavity of the cylinder 46 and exhausting air from the upper chamber of the interior cavity of the cylinder 46. The other end portion of the air tube 56 is connected to an air supply port 58A and an exhaust port 58B of a three-port solenoid valve 58. Thus, the cylinder 46 can be connected to an air supply source 60 (shown as a block in the drawings), via the air tube 56 and the air supply port 58A of the three-port solenoid valve 58. The three-port solenoid valve 58 is also connected to the control unit 62. At pre-specified set timings, the control unit 62 may control the direction of rising/falling of the weft-gripping pin 50 by controlling to switch which port of the three-port solenoid valve 58 is connected to the other end portion of the air tube 56 and controlling the three-port solenoid valve 58. Thus, control may be performed to grip the tip portion of the weft Y against the inner surface of the weft-gripping passage 42 (the insertion passage 38) when the tip portion of the weft Y has reached the weft-gripping passage 42.

[0042] The control unit 62 may perform control so as to switch which port of the three-port solenoid valve 58 is connected to the other end portion of the air tube 56, at predetermined timings in accordance with swinging angles of the sley 12, or may perform control so as to switch which port of the three-port solenoid valve 58 is connected to the other end portion of the air tube 56, at predetermined timings that are calculated on the basis of timings of injection and supply of the weft Y and the flying speed of the weft Y.

[0043] On the other hand, as shown in Fig. 1, a tensioning arm 64, which serves as a tensioning member, is arranged at the fell side of the loom 10 in correspondence with the space between the modified reed 16 and the weft-gripping block 34. A proximal end portion 64A of the tensioning arm 64 is fixed by fastening with screws 29 to a mounting base 28. Thus, the tensioning arm 64 is fixed to a loom frame 26 via the mounting base 28, and the tensioning arm 64 protrudes in the direction toward the space between the modified reed 16 and the weft-gripping mechanism part 32 from the fell side thereof. The loom frame 26 constitutes a stationary portion that does not displace during swinging of the modified reed 16. Accordingly, the tensioning arm 64 comes into contact with the weft Y between the modified reed 16 and the weft-gripping mechanism part 32 (between the picking direction downstream end of the modified reed 16 and the picking direction upstream end of the weft-gripping mechanism part 32) when the modified reed 16 is swinging in the beating direction in the state in which the tip portion of the weft Y is gripped by the weft-gripping mechanism part 32, and the tensioning arm 64 applies tension to the weft Y by relative displacement with respect

to the modified reed 16 (see Fig. 2).

[0044] The tensioning arm 64 is formed in a thin plate shape and is arranged with the plate thickness direction thereof in the left-and-right direction of the loom 10. A distal end portion 64B of the tensioning arm 64 is formed in a circular arc shape, and an upper edge portion at the distal end portion 64B side of the tensioning arm 64 is a guide portion 64C that is gently angled (at a shallow gradient) to the upper side toward the proximal end portion 64A side. The guide portion 64C comes into contact with the weft Y when the modified reed 16 swings in the beating direction, and guides a contacting portion of the weft Y in an upward direction relative to the height position of the picking passage 20 of the modified reed 16 (see Fig. 2 and Fig. 3). A portion of the upper edge portion of the tensioning arm 64 that continues from the opposite side of the guide portion 64C from the side at which the distal end portion 64B is provided extends substantially horizontally in the present exemplary embodiment.

- Operation and Effects -

[0045] Next, operation and effects of the above exemplary embodiment are described.

[0046] When the weft Y is injected and supplied (ejected) from the main nozzle for picking, which is not shown in the drawings, at the left side of the front elevation of the loom 10 shown in Fig. 1, the weft Y flies along the picking passage 20 in accordance with relay ejection operations by the plural sub-nozzles 22 for picking (of which only one is shown in the drawings). When the tip portion of the weft Y reaches a predetermined position at a fabric end side, the arrival of the weft Y is detected by the weft detection sensor 24, and this detection result is outputted to the control unit 62. The tip portion side of the weft Y is inserted into the insertion passage 38 of the weft-gripping block 34 by the ejection operation (jetting) of the sub-nozzle 22 that is disposed at the downstream side, and passes through the weft introduction passage 40 of the insertion passage 38. Then, in the process of passing through the weft-gripping passage 42, a distal end portion of the weft Y is stopped by the proximal end portion side of the weft Y being stopped by the weft engaging pin, which is not shown in the drawings, at the yarn supply side of the fabric (the left side in Fig. 1).

[0047] Thereafter, at a pre-specified set timing, the port of the three-port solenoid valve 58 that is connected to the air tube 56 shown in Fig. 3 is switched from the exhaust port 58B to the air supply port 58A, high-pressure air is supplied into the cylinder 46 of the air cylinder mechanism 44, and the weft-gripping pin 50 is pushed downward by this high pressure. Then, by the weft-gripping pin 50 being actuated by the air cylinder mechanism 44, the tip portion of the weft Y is gripped between the distal end portion 50A of the weft-gripping pin 50 and the inner surface of the weft-gripping passage 42.

[0048] When the modified reed 16 swings in the beating direction in this gripping state, the modified reed 16

and weft-gripping block 34 shown in Fig. 1 are moved in the fell direction by the swinging operation of the sley 12, and a portion of the weft Y comes into contact with the tensioning arm 64 between the modified reed 16 and the weft-gripping mechanism part 32. Then, when the modified reed 16 and the like move further toward the fell side, the weft Y is supported by the tensioning arm 64, and the contacting portion of the weft Y shown in Fig. 2 is guided in the upward direction relative to the height position of the picking passage 20 of the modified reed 16, by the guide portion 64C of the tensioning arm 64, while a portion of the weft Y is inflected and formed into an inverted "V" shape. In other words, the weft Y is supported by the tensioning arm 64 and tension is applied by relative displacement between the tensioning arm 64 and the modified reed 16.

[0049] Subsequently, at a crank angle close to 300°, a predetermined tension is applied to the weft Y at the side of the fabric opposite the yarn supply side, and the shed of the selvage yarn T2 at the fabric end is closed. At the initial stage, support points of the above-mentioned inverted V shape of the weft Y, shown in Fig. 3, are an upper wall of the picking passage 20 of the modified reed 16, the weft gripping position by the weft-gripping pin 50, and the upper edge portion of the tensioning arm 64. Later, the upper end of the entry portion 38A of the weft introduction passage 40 becomes a support point. Thus, tension is applied to the weft Y between these support points.

[0050] Then, after the beating of the weft Y, electrification of the three-port solenoid valve 58 is stopped by control from the control unit 62 such that the gripping force of the weft Y by the weft-gripping pin 50 is loosened, and at the same time the port of the three-port solenoid valve 58 that is connected to the air tube 56 is switched from the air supply port 58A to through the exhaust port 58B, and the high-pressure air is exhausted through the exhaust port 58B.

[0051] In the present exemplary embodiment as described above, high-pressure air is consumed only when the weft Y is being gripped, and no air at all is consumed while tension in the weft Y is being maintained. Therefore, compared with a comparative structure (for example, a weft tensioning device according to the aforementioned JP-A No. 10-204751) in which high-pressure air is continuously ejected from before the tip portion of a weft reaches a retention position until just before beating, air consumption amounts may be greatly reduced. In addition, because a uniform tension state is provided over the whole length of the weft by tensioning operations at the yarn supply side and the side opposite the yarn supply side, a high-quality fabric may be woven.

[0052] The support point at the tensioning arm 64 when tension is being applied to the weft Y is the upper edge portion of the tensioning arm 64, and the guide portion 64C at the upper edge portion of the tensioning arm 64 (see Fig. 1) guides the contacting portion of the weft Y relative to the height position of the picking passage 20

of the modified reed 16. Therefore, there is no risk of the weft Y disengaging from the tensioning arm 64 when tension is being applied to the weft Y.

[0053] The insertion passage 38 of the weft-gripping block 34 (the weft introduction passage 40, the weft-gripping passage 42 and the release passage 43) is enclosed at the periphery thereof by the wall surface. Therefore, the inserted weft Y essentially will not disengage from the passage, and stable gripping of the weft Y is possible.

[0054] In the weft tensioning device 30 according to the present exemplary embodiment, ejection operations of the sub-nozzles 22 are used to guide the weft Y into the insertion passage 38. Because the opening area of the entry portion 38A of the insertion passage 38 is set about 20% larger than the passage cross-sectional area of the picking passage 20 of the modified reed 16, the tip portion of the weft Y may smoothly enter into the insertion passage 38 from the picking passage 20 of the modified reed 16. Then, because the insertion passage 38 is formed such that the passage cross-sectional area progressively decreases from the entry portion 38A side toward the region at which the tip portion of the weft Y is gripped, the tip portion of the weft Y may smoothly enter into the weft-gripping passage 42 while flying. Because the passage cross-sectional area of the weft-gripping passage 42 is around 30% of the passage cross-sectional area of the picking passage 20, the operation stroke of the weft-gripping pin 50 may be limited. As a result, the loom 10 is compatible even with high-speed picking, in addition to which there are benefits in regard to durability.

[0055] Now, a preferable range of the ratio between the passage cross-sectional area Sa of the picking passage (20) of the modified reed (16) illustrated in Fig. 15A (the shaded region) and the passage cross-sectional area Sb of the weft-gripping passage (42) of the weft-gripping block (34) illustrated in Fig. 15B (the shaded region) is described.

[0056] Fig. 13 shows, in a graph, relationships between the passage cross-sectional area ratio between the picking passage (20) of the modified reed (16) and the weft-gripping passage (42) of the weft-gripping block (34) and corresponding response times of the weft-gripping pin 50. This graph shows results for when the passage cross-sectional area Sa of the picking passage (20) of the modified reed (16) is set to a predetermined value (a constant) and the passage cross-sectional area Sb of the weft-gripping passage (42) of the weft-gripping block (34) is varied.

[0057] As shown in Fig. 13, the greater the passage cross-sectional area ratio, the longer the response time of the weft-gripping pin (50). This is because the stroke of the weft-gripping pin (50) is longer when the passage cross-sectional area ratio is greater. The three-port solenoid valve (58) that supplies high-pressure air from one side of the weft-gripping pin (50) has a slower response time than a five-port solenoid valve that supplies high-pressure air from both sides of the weft-gripping pin (50).

However, the three-port solenoid valve (58) is advantageous in view of suppressing air consumption amounts and solenoid valve driving power, and having lower initial costs. That is, which of the three-port solenoid valve (58) and the five-point solenoid valve to employ should be determined in accordance with needs.

[0058] Fig. 14 shows, in a graph, relationships between the passage cross-sectional area ratio between the picking passage (20) of the modified reed (16) and the weft-gripping passage (42) of the weft-gripping block (34) and corresponding ease of entry of the weft (Y) into the weft-gripping block (34). Similarly to the graph of Fig. 13, this graph shows results for when the passage cross-sectional area S_a of the picking passage (20) of the modified reed (16) is set to a predetermined value (a constant) and the passage cross-sectional area S_b of the weft-gripping passage (42) of the weft-gripping block (34) is varied. As shown in Fig. 14, regardless of how thick the weft (Y) is, it is harder for the weft (Y) to enter the weft-gripping passage (42) when the passage cross-sectional area ratio is smaller.

[0059] From Fig. 13 and Fig. 14, it can be seen that passage cross-sectional area ratios with which the response time of the weft-gripping pin (50) is short but it is easy for the weft (Y) to enter the weft-gripping passage (42) are in the range from 20% to 70%. Thus, it is preferable to set the relationship between the passage cross-sectional area S_b at the region of the insertion passage (38) at which the tip portion of the weft (Y) is gripped between the weft-gripping pin (50) and the insertion passage (38) and the passage cross-sectional area S_a of the picking passage (20) of the modified reed (16) to $0.2S_a \leq S_b \leq 0.7S_a$.

[0060] In the weft tensioning device 30 according to the present exemplary embodiment, as shown in Fig. 4A and Fig. 4B, the width dimension 50W of the distal end portion 50A of the weft-gripping pin 50 as viewed in the insertion direction of the insertion passage 38 is set to be larger than the minimum width dimension 38W of the insertion passage 38. Therefore, whatever width direction position the weft Y passes through at, the weft Y may be more reliably gripped inside the insertion passage 38.

[0061] Of the weft-gripping pin 50, the small diameter portion 50B is formed continuously from the distal end portion 50A and with a smaller diameter than the distal end portion 50A, and the weft-gripping pin 50 is specified such that at least a portion of the small diameter portion 50B is disposed inside the weft-gripping passage 42 (the insertion passage 38) in the state in which the weft-gripping pin 50 grips the tip portion of the weft Y against the inner surface of the weft-gripping passage 42 (the insertion passage 38). Therefore, as shown in Fig. 4B, in the weft Y gripping state, gaps B are formed between the small diameter portion 50B and the weft-gripping passage 42 (the insertion passage 38). Therefore, even when air for picking flows into the insertion passage 38 due to being jetted from the sub-nozzles 22 (see Fig. 1) in the weft Y gripping state, this air flows out through the

gaps B. That is, occurrences of reverse flows due to this airflow being blocked by the weft-gripping pin 50 may be suppressed, and weft Y gripping performance may be made even more stable.

[0062] As shown in Fig. 1, the tensioning arm 64 protrudes in the direction toward the space between the modified reed 16 and the weft-gripping mechanism part 32 from the fell side. Therefore, when the tip portion of the weft Y is inserted into the insertion passage 38 of the weft-gripping mechanism part 32 during the swinging of the modified reed 16 (that is, before the weft Y comes into contact with the guide portion 64C of the tensioning arm 64 and before the tip portion of the weft Y is gripped by the weft-gripping mechanism part 32), ejections (airflows) from the sub-nozzles 22 for picking enter into the insertion passage 38 of the weft-gripping mechanism part 32 without being obstructed by (conflicting with) the tensioning arm 64 that is separated to the fell side. Therefore, even though the tensioning arm 64 is arranged for tensioning the weft Y, smooth picking is possible. Moreover, because the tensioning arm 64 is structured by a single thin plate, initial costs may be kept down.

[0063] As described hereabove, according to the weft tensioning device 30 in accordance with the present exemplary embodiment, tension may be applied to the weft Y while an amount of air consumption is suppressed.

- Second Exemplary Embodiment -

[0064] Next, a weft tensioning device in accordance with a second exemplary embodiment of the present invention is described using Fig. 5 and Fig. 6. Fig. 5 shows principal portions of a weft tensioning device 70 according to the present exemplary embodiment in a vertical sectional diagram in a front elevation. Fig. 6 shows a state of arrangement of tensioning arms 64 and 72, which serve as tensioning members of the weft tensioning device 70, in a perspective view. As shown in these drawings, the weft tensioning device 70 differs from the weft tensioning device 30 according to the first exemplary embodiment (see Fig. 1, etc.) in that the two tensioning arms 64 and 72 are provided. Other structures are substantially the same as in the first exemplary embodiment. Therefore, structural portions that are substantially the same as in the first exemplary embodiment are assigned the same reference numerals and are not described, and portions other than characteristic portions of the present exemplary embodiment are partially omitted from the drawing of Fig. 6.

[0065] As shown in Fig. 5 and Fig. 6, the tensioning arms 64 and 72 are arranged side by side with a constant spacing in the picking direction of the weft Y. Similarly to the tensioning arm 64, the tensioning arm 72 neighboring the tensioning arm 64 is disposed at the fell side of the loom 10 in correspondence with the space between the modified reed 16 and the weft-gripping block 34. A proximal end portion 72A of the tensioning arm 72 is fixed by fastening with the screws 29 to the mounting base 28,

and is fixed to the loom frame 26 via the mounting base 28. The tensioning arm 72 protrudes in the direction toward the space between the modified reed 16 and the weft-gripping mechanism part 32 from the fell side thereof. Accordingly, the tensioning arm 72 comes into contact with the weft Y between the modified reed 16 and the weft-gripping mechanism part 32 (between the picking direction downstream end of the modified reed 16 and the picking direction upstream end of the weft-gripping mechanism part 32) when the modified reed 16 is swinging in the beating direction in the state in which the tip portion of the weft Y is gripped by the weft-gripping mechanism part 32, and the tensioning arm 72 applies tension to the weft Y by relative displacement with respect to the modified reed 16.

[0066] The tensioning arm 72 is a member with the same shape as the tensioning arm 64 but is mounted in a state of being vertically inverted. A distal end portion 72B is formed in a circular arc shape, and a lower edge portion at the distal end portion 72B side is formed as a guide portion 72C that is gently angled (at a shallow gradient) to the lower side toward the proximal end portion 72A side. The guide portion 72C comes into contact with the weft Y when the modified reed 16 swings in the beating direction, and guides a contacting portion of the weft Y in the downward direction relative to the height position of the picking passage 20 of the modified reed 16. A portion of the tensioning arm 72 at the lower edge portion that continues from the opposite side of the guide portion 72C from the side at which the distal end portion 72B is provided extends substantially horizontally in the present exemplary embodiment.

[0067] That is, the tensioning arms 64 and 72 come into contact with the weft Y while the modified reed 16 is swinging in the beating direction, guide contacting portions of the weft Y in the up-and-down direction relative to the height position of the picking passage 20 in the modified reed 16, and are specified such that each guiding direction is vertically opposite to that of the neighboring other tensioning member (72 or 64).

[0068] According to the structure of the present exemplary embodiment, substantially the same operations and effects as in the above-described first exemplary embodiment are provided. In addition, because a deformation stroke of the weft Y may be lengthened easily (that is, an amount by which the weft Y is stretched may easily be set to be larger), the present exemplary embodiment is useful when a stretchy fiber with extensibility is used for the weft Y. In a case in which it is necessary to extend the weft Y further, three or more of the tensioning arms may be provided in a row.

- Third Exemplary Embodiment -

[0069] Next, a weft tensioning device in accordance with a third exemplary embodiment of the present invention is described using Fig. 7. Fig. 7 shows principal portions of a weft tensioning device 80 according to the

present exemplary embodiment in a vertical sectional diagram in a front elevation. As shown in this drawing, the weft tensioning device 80 differs from the weft tensioning device 30 according to the first exemplary embodiment (see Fig. 1, etc.) in that a five-port solenoid valve 82 is provided instead of the three-port solenoid valve 58. Other structures are substantially the same as in the first exemplary embodiment. Therefore, structural portions that are substantially the same as in the first exemplary embodiment are assigned the same reference numerals and are not described,

[0070] In the present exemplary embodiment, the opening area of the entry portion 38A of the insertion passage 38 shown in Fig. 7 (the weft introduction passage 40) is specified to be 50% larger than the passage cross-sectional area of the picking passage 20 of the modified reed 16, and the passage cross-sectional area of the weft-gripping passage 42 is specified to be about 50% of the passage cross-sectional area of the weft introduction passage 40.

[0071] One end portion of the air tube 56 for supplying air to the upper chamber of the interior cavity of the cylinder 46 and exhausting air from the upper chamber of the interior cavity of the cylinder 46 is connected to the upper end of the weft-gripping block 34, and the other end portion of the air tube 56 is connected to either an air supply port 82A or an exhaust port 82C of the five-port solenoid valve 82. In addition, one end portion of a pipe-form air tube 56A for supplying air to the lower chamber of the interior cavity of the cylinder 46 and exhausting air from the lower chamber of the interior cavity of the cylinder 46 is connected to a side portion of the weft-gripping block 34, and the other end portion of the air tube 56A is connected to either an exhaust port 82B or an air supply port 82D of the five-port solenoid valve 82.

[0072] Further, the cylinder 46 can be connected with the air supply source 60 via the air tube 56 and the air supply port 82A of the five-port solenoid valve 82, or can be connected with the air supply source 60 via the air tube 56A and the air supply port 82D of the five-port solenoid valve 82. The five-port solenoid valve 82 is connected to the control unit 62. At pre-specified set timings, the control unit 62 may control the direction of rising/falling of a weft-gripping pin 84 that serves as the pressing member by controlling to switch which ports of the five-port solenoid valve 82 are connected to the other end portions of the air tubes 56 and 56A and controlling the five-port solenoid valve 82. The timings at which the ports of the five-port solenoid valve 82 are switched between are similar to the timings in the first exemplary embodiment.

[0073] The weft-gripping pin 84 has a similar structure to the weft-gripping pin 50 of the first exemplary embodiment (see Fig. 4A), except that the small diameter portion 50B (see Fig. 4A) is not formed. That is, the weft-gripping pin 84 is a structure in which a short circular column-shaped piston portion 84P is coaxially and integrally provided at one axial direction end portion of a pin main body

84H in a substantially circular rod shape with a small diameter. In the drawing, structural portions of the weft-gripping pin 84 that are the same as in the weft-gripping pin 50 of the first exemplary embodiment (see Fig. 4A) are assigned the same reference numerals. In the present exemplary embodiment, the compression coil spring 54 of the first exemplary embodiment (see Fig. 3) is not disposed inside the cylinder 46.

[0074] According to the structure of the present exemplary embodiment, substantially the same operations and effects as in the above-described first exemplary embodiment are provided. In addition, high operational performance may be assured even when a very thick yarn is used for the weft Y. To clarify, because the passage cross-sectional areas of the entry portion 38A of the insertion passage 38 (the weft introduction passage 40) and the weft-gripping passage 42 are specified to be large, insertion of the weft Y into the weft-gripping passage 42 is easy even if a very bulky yarn is being used for the weft Y. Meanwhile, although the operation stroke of the weft-gripping pin 84 is longer in accordance with the increase in the passage cross-sectional area of the weft-gripping passage 42, because the five-port solenoid valve 82 is employed for the driving of the weft-gripping pin 84, operations of the weft-gripping pin 84 are faster and therefore responsiveness when gripping the weft Y is assured.

- Fourth Exemplary Embodiment -

[0075] Next, a weft tensioning device in accordance with a fourth exemplary embodiment of the present invention is described using Fig. 8. Fig. 8 shows principal portions of a weft tensioning device 90 according to the present exemplary embodiment in a plan diagram. As shown in this drawing, the weft tensioning device 90 differs from the weft tensioning device 30 according to the first exemplary embodiment (see Fig. 1, etc.) in that an air passage part 92 for jetting air toward the weft detection sensor 24 is formed. Other structures are substantially the same as in the first exemplary embodiment. Therefore, structural portions that are substantially the same as in the first exemplary embodiment are assigned the same reference numerals and are not described.

[0076] As shown in Fig. 8, an ejection aperture 94A of a cleaning nozzle 94 is provided adjacent to the weft Y picking direction downstream side of the picking passage 20 of the modified reed 16. This ejection aperture 94A is arranged to oppose a detection surface 24A of the weft detection sensor 24, with the modified reed 16 interposed therebetween. The cleaning nozzle 94 is mounted at the rear face side of the modified reed 16, and one end portion of an air tube 96 is connected to a proximal end portion side of the cleaning nozzle 94. The other end portion of the air tube 96 is connected to the exhaust port 58B of the three-port solenoid valve 58. That is, the cleaning nozzle 94 and the air tube 96 structure the air passage part 92, which is for ejecting exhaust air that has been

supplied to and used at the air cylinder mechanism 44 from the ejection aperture 94A.

[0077] According to the structure of the present exemplary embodiment, high-pressure air exhausted from the cleaning nozzle 94 is jetted through gaps between the reed dents 18 at the detection surface 24A of the weft detection sensor 24. Because the cleaning nozzle 94 is installed thus, high-pressure air that has been used for driving of the weft-gripping pin 50 is not purposelessly released into the atmosphere but may perform cleaning of the detection surface 24A of the weft detection sensor 24, which is vulnerable to the adherence of cotton fly, once for each picking. According to the present exemplary embodiment as described above, the same operations and effects as in the above-described first exemplary embodiment are provided, in addition to which reliable picking detection is possible.

- Fifth Exemplary Embodiment -

[0078] Next, a weft tensioning device in accordance with a fifth exemplary embodiment of the present invention is described using Fig. 9. Fig. 9 shows an operational diagram in a side elevation for describing operation of a weft tensioning device 100 according to the present exemplary embodiment. In the drawing, structural portions that are at the near side of the drawing relative to a tensioning arm 102 that serves as the tensioning member are not shown, and states of displacement of the modified reed 16 and a portion of the weft are shown by two-dot chain lines.

[0079] As shown in the drawing, the present exemplary embodiment differs from the weft tensioning device 30 according to the first exemplary embodiment (see Fig. 1, etc.) in that a circular arc portion 102A is formed at the upper edge portion of the tensioning arm 102. Other structures are substantially the same as in the first exemplary embodiment. Structural portions that are substantially the same as in the first exemplary embodiment are assigned the same reference numerals and are not described.

[0080] The tensioning arm 102 shown in Fig. 9 protrudes in the direction toward the space between the modified reed 16 and the weft-gripping mechanism part 32 (see Fig. 1) from the fell side, and has the same structure as the tensioning arm 64 of the first exemplary embodiment (see Fig. 1) apart from the formation of the circular arc portion 102A at the upper edge portion. Thus, structural portions that are the same are assigned the same reference numerals and are not described. The circular arc portion 102A of the tensioning arm 102 is continuous from the guide portion 64C and is provided at the fell side thereof. The circular arc portion 102A is formed in a circular arc shape along the swinging direction of the modified reed 16 (so as to match the path of the swinging movement).

[0081] At the time of tensioning of the weft Y, the weft Y comes into contact with the circular arc portion 102A

and is supported. The amount of stretching of the weft Y in this state is set in accordance with a distance L1 between a position of the circular arc portion 102A and the upper wall position of the guide holes 18A. Because the circular arc portion 102A is formed in a circular arc shape along the swinging direction of the modified reed 16 (see the direction of arrow A), the distance L1 between the position of the circular arc portion 102A and the upper wall position of the guide holes 18A is constant, so a stretching amount of the weft Y is constant.

[0082] According to the structure of the present exemplary embodiment, substantially the same operations and effects as in the above-described first exemplary embodiment are provided. In addition, in the state in which the weft Y is in contact with and supported by the circular arc portion 102A, even when the modified reed 16 changes in position due to the swinging of the sley 12 (any of the positions marked with the reference numerals 16A, 16B and 16C in Fig. 9), the stretching amount of the weft Y can be kept constant. Thus, more consistent fabric quality is provided.

- Sixth Exemplary Embodiment -

[0083] Next, a weft tensioning device in accordance with a sixth exemplary embodiment of the present invention is described using Fig. 10. Fig. 10 shows an operational diagram in a side elevation for describing operation of a weft tensioning device 110 according to the present exemplary embodiment. In the drawing, structural portions that are at the near side of the drawing relative to a tensioning arm 112 that serves as the tensioning member are not shown, and states of displacement of the modified reed 16 and a portion of the weft are shown by two-dot chain lines.

[0084] As shown in the drawing, the tensioning arm 112 in the present exemplary embodiment has the same structure as the tensioning arm 72 of the second exemplary embodiment (see Fig. 6) except that a circular arc portion 112A is formed at the lower edge portion of the tensioning arm 112. The tensioning arm 112 protrudes in the direction toward the space between the modified reed 16 and the weft-gripping mechanism part 32 (see Fig. 1) from the fell side. Thus, structural portions that are substantially the same as in the tensioning arm 72 (see Fig. 6) are assigned the same reference numerals and are not described. Other structures of the weft tensioning device 110 are substantially the same as in the first exemplary embodiment. Structural portions that are substantially the same as in the first and second exemplary embodiments are assigned the same reference numerals and are not described.

[0085] The circular arc portion 112A of the tensioning arm 112 shown in Fig. 10 is continuous from the guide portion 72C and is provided at the fell side thereof. The circular arc portion 112A is formed in a circular arc shape along the swinging direction of the modified reed 16 (so as to match the path of the swinging movement).

[0086] At the time of tensioning of the weft Y, the weft Y comes into contact with the circular arc portion 112A and is supported. The amount of stretching of the weft Y in this state is set in accordance with a distance L2 between a position of the circular arc portion 112A and the lower wall position of the guide holes 18A. Because the circular arc portion 112A is formed in a circular arc shape along the swinging direction of the modified reed 16 (see the direction of arrow A), the distance L2 between the position of the circular arc portion 112A and the lower wall position of the guide holes 18A is constant, so a stretching amount of the weft Y is constant.

[0087] According to the structure of the present exemplary embodiment, substantially the same operations and effects as in the above-described first exemplary embodiment are provided. In addition, the same operations and effects as in the above-described fifth exemplary embodiment are provided.

- Seventh Exemplary Embodiment -

[0088] Next, a weft tensioning device in accordance with a seventh exemplary embodiment of the present invention is described using Fig. 11. Fig. 11 shows principal portions of a weft tensioning device 120 according to the present exemplary embodiment in a vertical sectional diagram in a front elevation. As shown in this drawing, the weft tensioning device 120 differs from the weft tensioning device 30 according to the first exemplary embodiment (see Fig. 1, etc.) in that an insertion passage 126 is provided instead of the insertion passage 38 and in that the air cylinder mechanism 44 is arranged with the axial direction of the weft-gripping pin 50 in a horizontal direction. Other structures are substantially the same as in the first exemplary embodiment. Therefore, structural portions that are substantially the same as in the first exemplary embodiment are assigned the same reference numerals and are not described, and portions other than characteristic portions of the present exemplary embodiment are partially omitted from the drawing of Fig. 11.

[0089] As shown in Fig. 11, the insertion passage 126 is formed penetrating through a weft-gripping block 122, and the insertion passage 126 is formed with a periphery thereof enclosed by a wall surface. At a weft introduction passage 128 that constitutes a portion of the insertion passage 126, an entry portion 126A is formed in a circular shape, and the weft introduction passage 128 is formed in a shape that narrows in a conical taper shape such that the passage cross-sectional area progressively reduces (constricts) from the entry portion 126A side toward a region at which the tip portion of the weft Y is gripped. A weft-gripping passage 130 that constitutes a portion of the insertion passage 126 is formed continuously with the weft introduction passage 128. An inner periphery shape of the weft-gripping passage 130 is formed in a circular tube interior surface shape. The insertion passage 126 has a similar structure to the insertion passage 38 (see Fig. 3, etc.) in other respects (that

is, the weft introduction passage 128 has a similar structure to the weft introduction passage 40 (see Fig. 3, etc.) and the weft-gripping passage 130 has a similar structure to the weft-gripping passage 42 (see Fig. 3, etc.).

[0090] The air cylinder mechanism 44 is inserted from the rear face side of the weft-gripping block 122. When the weft-gripping pin 50 is to grip the weft Y against the inner surface of the weft-gripping passage 130, the weft-gripping pin 50 operates toward the fell side (the left side in the drawing) from the side opposite the fell side (the right side in the drawing).

[0091] The weft-gripping block 122 has the same structure as the weft-gripping block 34 of the first exemplary embodiment (see Fig. 1) except in the respects described above, and is fixed on the sleigh 12.

[0092] With the structure of the present exemplary embodiment described above too, the same operations and effects as in the above-described first exemplary embodiment are provided. In addition, because the shapes of the weft introduction passage 128 and the weft-gripping passage 130 are as described hereabove, fabrication costs of the weft-gripping block 122 may be greatly reduced.

- Eighth Exemplary Embodiment -

[0093] Next, a weft tensioning device in accordance with an eighth exemplary embodiment of the present invention is described using Fig. 12. Fig. 12 shows principal portions of a weft tensioning device 140 according to the present exemplary embodiment in a side view. As shown in this drawing, the weft tensioning device 140 differs from the weft tensioning device 30 according to the first exemplary embodiment (see Fig. 1, etc.) in that the tensioning arm 64 can be moved by a movement mechanism 142. Other structures are substantially the same as in the first exemplary embodiment. Therefore, structural portions that are substantially the same as in the first exemplary embodiment are assigned the same reference numerals and are not described, and portions other than characteristic portions of the present exemplary embodiment are partially omitted from the drawing of Fig. 12.

[0094] As shown in Fig. 12, the movement mechanism 142 is equipped with a vertical column portion 144. A rack 146 that extends in the up-and-down direction of the loom 10 is fixed to the vertical column portion 144, and guide rails 148 that extend in parallel with the rack 146 are formed at two sides of the rack 146. Stoppers 149 are disposed at upper and lower ends of the guide rails 148. Correspondingly, a pinion 150 that meshes with the rack 146 is turnably supported at the mounting base 28, and sliders 152 that are capable of sliding movement (rubbing movement) along the length direction of the guide rails 148 are fixed to the mounting base 28. The pinion 150 can be driven by a motor, which is not shown in the drawings. The mounting base 28 is raised by the motor driving forward, and the mounting base 28 is lowered by the motor driving in reverse.

[0095] A horizontal column portion 154, which is fixed to the loom frame 26 and extends in the front-and-rear direction of the loom 10, is provided at the lower end portion side of the vertical column portion 144. A rack 156 that extends along the length direction of the horizontal column portion 154 is fixed to the horizontal column portion 154, and guide rails 158 that extend in parallel with the rack 156 are formed above and below the rack 156. Stoppers 159 are disposed at left and right ends of the guide rails 158. On the other hand, a pinion 160 that meshes with the rack 156 is turnably supported at the lower end portion side of the vertical column portion 144, and sliders 162 that are capable of sliding movement (rubbing movement) along the length direction of the guide rails 158 are fixed to the lower end portion side of the vertical column portion 144. The pinion 160 can be driven by a motor, which is not shown in the drawings. The vertical column portion 144 is moved to the side of the loom 10 away from the fell (the right side in the drawing) by the motor driving forward, and the vertical column portion 144 is moved toward the fell side of the loom 10 (the left side in the drawing) by the motor driving in reverse.

[0096] That is, the movement mechanism 142 moves the tensioning arm 64 in the up-and-down direction and in a horizontal direction that is orthogonal to the picking direction of the weft Y by motor driving. Similarly to the first exemplary embodiment, the tensioning arm 64 protrudes in the direction toward the space between the modified reed 16 and the weft-gripping mechanism part 32, and the attitude thereof is fixed.

[0097] In the structure of the present exemplary embodiment described hereabove, the same operations and effects as in the above-described first exemplary embodiment are provided. In addition, setting of the position of the tensioning arm 64 in accordance with types of the weft Y and picking conditions and the like may be made easy.

- Ninth Exemplary Embodiment -

[0098] Next, a weft tensioning device in accordance with a ninth exemplary embodiment of the present invention is described using Fig. 16 to Fig. 21. Fig. 16 shows a weft tensioning device 170 according to the present exemplary embodiment of the present invention, in the state when picking is complete, in a perspective view. Fig. 17 shows the weft tensioning device 170, in the state in which the weft Y is being tensioned, in a perspective view. Fig. 18 shows principal portions of the weft tensioning device 170 in a vertical sectional diagram in a front elevation. Fig. 19 shows the weft tensioning device 170, in a section cut at a position of a weft-gripping passage 178, in a vertical sectional diagram in a side elevation. Fig. 20 shows the weft tensioning device 170, in a section cut at a position close to a position of arrangement of the tensioning arm 64, in a vertical sectional diagram in a side elevation.

[0099] Structures other than the structures described below are substantially the same as in the first exemplary embodiment. Further, structural portions that are substantially the same as in the first to eighth exemplary embodiments are assigned the same reference numerals and are not described.

[0100] As shown in Fig. 16 to Fig. 19, a lower portion of a weft-gripping block 172 is fixed to the weft tensioning device 170 at the front face side of the sley 12. As is shown in Fig. 16, the weft-gripping block 172 is arranged at the front side of the modified reed 16, and a mounting position of the weft-gripping block 172 can be altered in the left-and-right direction in accordance with specified fabric widths. An insertion portion 172A that fits into the guide holes 18A of the modified reed 16 is provided at an upper end portion of the weft-gripping block 172. A picking direction upstream side portion of the insertion portion 172A is formed with an outer profile in a side sectional view that is the same shape as the shape of the guide holes 18A in side view. That is, no gaps through which the ejections by the sub-nozzles 22 can penetrate to the picking direction downstream side are formed between the picking direction upstream side portion of the insertion portion 172A and the guide holes 18A.

[0101] As shown in Fig. 16 and Fig. 19, an insertion passage 174 is formed in an upper end portion of the weft-gripping block 172 including the insertion portion 172A. As shown in Fig. 18, the insertion passage 174 is formed with the periphery thereof enclosed by a wall surface, and the tip portion of the weft Y can be inserted therein. A weft introduction passage 176 constitutes the picking direction upstream side of the insertion passage 174. The weft insertion passage 176 is formed with an insertion portion 174A (see Fig. 19) in a substantially elliptical shape that is longer substantially in the front-and-rear direction of the loom 10 (a direction substantially perpendicular to the drawing of Fig. 18). The weft introduction passage 176 is formed in a shape (see Fig. 19) such that an upper face side and a further face side (the further side of the drawing of Fig. 18) progressively decrease in diameter (constrict) from the insertion portion 174A side toward the side of a region at which the tip portion of the weft Y is gripped (the right side in Fig. 18). The weft-gripping passage 178 constitutes the picking direction downstream side of the insertion passage 174. The weft-gripping passage 178 is continuous with the weft introduction passage 176, and an inner periphery surface thereof is formed in a circular tube interior surface shape (see Fig. 19).

[0102] As shown in Fig. 16, plural vent holes 180 are formed at the weft introduction passage 176 and the weft-gripping passage 178. The vent holes 180 penetrate from the weft introduction passage 176 and the weft-gripping passage 178 to the fell side of the weft-gripping block 172, and form exhaust passages for guiding ejections by the sub-nozzles 22 from inside the insertion passage 174 to outside the weft-gripping block 172. That is, the vent holes 180 have the function of suppressing air resistance

of airflows inside the insertion passage 174. As a variant example, the vent holes 180 may penetrate from the weft introduction passage 176 and the weft-gripping passage 178 in other directions, such as to the upper side, the lower side and the opposite side from the fell side (the further side) of the weft-gripping block 172, or the like. An overall cross-sectional area of the plural vent holes 180 in directions perpendicular to the penetration directions thereof is specified to be equal to or greater than a cross-sectional area of the weft-gripping passage 178 in the directions perpendicular to the direction in which the weft-gripping passage 178 extends.

[0103] The insertion passage 174 has the same structure as the insertion passage 38 of the first exemplary embodiment (see Fig. 3, etc.) in other respects. That is, the weft introduction passage 176 has the same structure as the weft introduction passage 40 (see Fig. 3, etc.) and the weft-gripping passage 178 has the same structure as the weft-gripping passage 42 (see Fig. 3, etc.).

[0104] As shown in Fig. 19, an air cylinder mechanism 182 is provided at the weft-gripping block 172. The air cylinder mechanism 182 has substantially the same structure as the air cylinder mechanism 44 of the first exemplary embodiment (see Fig. 3), except that the weft-gripping pin 84 according to the third exemplary embodiment (see Fig. 7) is provided instead of the weft-gripping pin 50 of the first exemplary embodiment (see Fig. 3) and in respect of the position of arrangement. In the air cylinder mechanism 182, when the weft-gripping pin 84 is to grip the weft Y against the inner surface of the weft-gripping passage 178, the air cylinder mechanism 182 activates the weft-gripping pin 84 to move diagonally upward toward the opposite side thereof from the fell side (toward the right side in Fig. 19).

[0105] As shown by the imaginary lines in Fig. 16, it is preferable that one of the sub-nozzles 22 for picking insertion is disposed adjacent to the picking direction upstream side relative to the weft-gripping block 172. In this structure, a duration of insertion of the weft Y into the insertion passage 174 may be made shorter than in a structure in which no sub-nozzle 22 is adjacent to the weft-gripping block 172.

[0106] As shown in Fig. 20, a pin-retaining part 184 that corresponds with the tensioning arm 64 is fixed on top of the wedge member 14 that is fixed to the sley 12. The mounting position of the pin-retaining part 184 can be changed in the left-and-right direction of the loom 10 (the direction perpendicular to the drawing of Fig. 20) together with the tensioning arm 64 in accordance with specified fabric widths. The pin-retaining part 184 is formed in an "L" shape in side view, being provided with a lower wall portion 184A, which is fixed to the wedge member 14, and a vertical wall portion 184B, which is disposed at the rear face side of the modified reed 16. A plate-shaped rubber member 190 is attached to the vertical wall portion 184B between the vertical wall portion 184B and a rear surface of the modified reed 16. An aperture portion 186, into which a portion at the distal end

portion 64B side of the tensioning arm 64 can be inserted, is formed penetrating through the vertical wall portion 184B.

[0107] Fig. 21 shows the pin-retaining part 184 in a front view. As shown in Fig. 21, the aperture portion 186 is formed at a central portion of the vertical wall portion 184B. Split pins 188 are fixed to the vertical wall portion 184B above and below the aperture portion 186. The split pins 188 protrude toward the fell side with axial directions thereof in directions perpendicular to the vertical wall portion 184B (see Fig. 20). As shown in Fig. 18, the split pins 188 are disposed at upper and lower positions sandwiching the guide holes 18A of the modified reed 16, are inserted between neighboring reed dents 18, and bend (resiliently deform) these reed dents 18 in lateral directions. Thus, the split pins 188 form a space into which the portion at the distal end portion 64B side of the tensioning arm 64 (see Fig. 20) can be inserted between these reed dents 18.

[0108] With the structure of the present exemplary embodiment described above too, the same operations and effects as in the above-described first exemplary embodiment are provided. Moreover, in the present exemplary embodiment, mounting positions of the weft-gripping block 172, the tensioning arm 64 and the pin-retaining part 184 (see Fig. 20) can be altered in the left-and-right direction. Therefore, tension may be applied to the weft Y in accordance with types and fabric width specifications.

- Supplementary Descriptions of the Embodiments -

[0109] In the exemplary embodiments described above, as shown in Fig. 3, Fig. 7 and the like, the weft-gripping pin 50 or 84 is structured with the short circular column-shaped piston portion 50P or 84P being co-axially and integrally provided at one axial direction end portion of the pin main body 50H or 84H with a substantially circular rod shape with a small diameter. However, for example, a piston may be disposed in the interior cavity of the cylinder of a cylinder mechanism, and the pressing member may be another pressing member, such as a member with a substantially square rod shape or a substantially circular rod shape that is fixed to an axial center portion of the piston, or the like.

[0110] In the exemplary embodiments described above, as shown in Fig. 3, Fig. 11 and the like, the insertion passage 38, 126 or 174 is formed such that the passage cross-sectional area is progressively reduced from the side of the entry portion 38A, 126A or 174A toward the side of the region at which the tip portion of the weft Y is gripped. This structure is preferable in regard to responsiveness and the like of the weft-gripping pin 50 or 84. However, a structure in which the passage cross-sectional area is constant from the insertion passage entry portion side towards the side of the region at which the tip portion of the weft is gripped is also possible.

[0111] In the above-described first exemplary embod-

iment and the like, the width dimension 50W of the distal end portion 50A of the weft-gripping pin 50 is specified to be larger than the minimum width dimension 38W of the insertion passage 38 as viewed in the insertion direction of the insertion passage 38. This structure is preferable in regard to more reliably gripping the weft Y inside the insertion passage 38. However, structures are also possible in which the width dimension of the distal end portion of the pressing member as viewed in the insertion direction of an insertion passage is specified to be very slightly more than the minimum width dimension of an insertion passage (for example, such that a gap between the two is less than the radius of a weft).

[0112] In the above-described first exemplary embodiment and the like, the small diameter portion 50B that is continuous with the distal end portion 50A and has a smaller diameter than the distal end portion 50A is formed at the weft-gripping pin 50. This structure is preferable in regard to suppressing occurrences of reverse flows of airflows for picking. However, a structure is also possible in which a small-diameter portion is not formed at the pressing member.

[0113] In the exemplary embodiments described above, the tensioning arm 64, 72, 102 or 112 is formed in a thin plate shape and the plate thickness direction thereof is arranged in the left-and-right direction of the loom 10. However, a tensioning member may, for example, be formed in a thick plate shape and arranged with the plate thickness direction thereof in the left-and-right direction of the loom 10, and may be formed in a shape such that a plate thickness direction central portion at the upper edge portion side or lower edge portion side that is to come into contact with the weft protrudes in a front view of the loom.

[0114] In the exemplary embodiments described above, the tensioning arm 64, 72, 102 or 112 is protruded from the fell side in the direction toward the space between the modified reed 16 and the weft-gripping mechanism part 32. This structure is preferable in regard to preventing ejections from the sub-nozzles 22 for picking from conflicting with the tensioning arm 64, 72, 102 or 112. However, the tensioning member may be, for example, another tensioning member such as a tensioning member that is provided between the modified reed 16 and the weft-gripping mechanism part 32 and extends in the up-and-down direction, or the like.

[0115] The exemplary embodiments described above and the numerous variant examples mentioned above may be embodied in suitable combinations.

[0116] The disclosures of Japanese Patent Application No. 2011-019763 and Japanese Patent Application No. 2012-015959 are incorporated into the present specification by reference in their entirety.

Claims

1. A weft tensioning device comprising:

a weft-gripping mechanism part that is arranged at the downstream side in a picking direction of a weft relative to a picking passage of a modified reed and that is fixed on a sley, the weft-gripping mechanism part comprising:

an insertion passage that is formed with a periphery being enclosed by a wall surface and into which a tip portion of the picked weft is inserted,
a pressing member that is capable of gripping the tip portion of the weft against an inner surface of the insertion passage, and
an air cylinder mechanism that actuates the pressing member and causes the pressing member to grip the tip portion of the weft; and

a tensioning member that is fixed to a loom frame, comes into contact with the weft between the modified reed and the weft-gripping mechanism part when the modified reed is swinging in a beating direction in the state in which the tip portion of the weft is gripped by the weft-gripping mechanism part, and applies tension to the weft by relative displacement with respect to the modified reed.

2. The weft tensioning device according to claim 1, wherein the insertion passage is specified such that an opening area of an entry portion thereof is equal to or greater than a passage cross-sectional area of the picking passage of the modified reed, and the insertion passage is formed such that a passage cross-sectional area thereof progressively decreases from the entry portion side toward the side of a region at which the tip portion of the weft is gripped.
3. The weft tensioning device according to claim 1 or claim 2, wherein the tensioning member protrudes from a fell side in a direction toward a space between the modified reed and the weft-gripping mechanism part, and the tensioning member includes a guide portion that makes contact with the weft when the modified reed is swinging in the beating direction and guides a contacting portion of the weft in an up-and-down direction relative to a height position of the picking passage of the modified reed.
4. The weft tensioning device according to claim 3, wherein the tensioning member comprises a circular arc portion that is continuous with the guide portion and provided at the fell side thereof, and that is formed in a circular arc shape along the direction of swinging of the modified reed.
5. The weft tensioning device according to any one of claims 1 to 4, wherein a width dimension of a distal

end portion of the pressing member as viewed in the insertion direction of the insertion passage is specified to be larger than a minimum width dimension of the insertion passage.

6. The weft tensioning device according to any one of claims 1 to 5, wherein a small diameter portion is formed at the pressing member, the small diameter portion being continuous with a distal end portion of the pressing member and having a smaller diameter than the distal end portion, and the pressing member being specified such that at least a portion of the small diameter portion is disposed inside the insertion passage in the state in which the tip portion of the weft is gripped between the pressing member and the inner surface of the insertion passage.
7. The weft tensioning device according to any one of claims 1 to 6, wherein the tensioning member is plurally provided in a row along the picking direction of the weft, each tensioning member coming into contact with the weft when the modified reed is swinging in the beating direction and guiding a contacting portion of the weft in the up-and-down direction relative to the height position of the picking passage of the modified reed, and the guiding direction being specified to be vertically opposite to the guiding direction of each neighboring other tensioning member.
8. The weft tensioning device according to any one of claims 1 to 7, further comprising an air passage portion that is formed for ejecting exhaust air that has been supplied to and used at the air cylinder mechanism from an ejection aperture, the ejection aperture being disposed adjacent to the weft picking direction downstream side of the picking passage of the modified reed and the ejection aperture being disposed to oppose a detection surface of a weft detection sensor that is for detection of the weft.
9. The weft tensioning device according to any one of claims 1 to 8, further comprising a movement mechanism provided at the loom frame, the movement mechanism moving the tensioning member in the up-and-down direction and a horizontal direction orthogonal to the picking direction of the weft by motor driving.
10. The weft tensioning device according to any one of claims 1 to 9, wherein a relationship between a passage cross-sectional area S_b of the region of the insertion passage at which the tip portion of the weft is gripped between the insertion passage and the pressing member and a passage cross-sectional area S_a of the picking passage of the modified reed is specified such that $0.2S_a \leq S_b \leq 0.7S_a$.

FIG.1

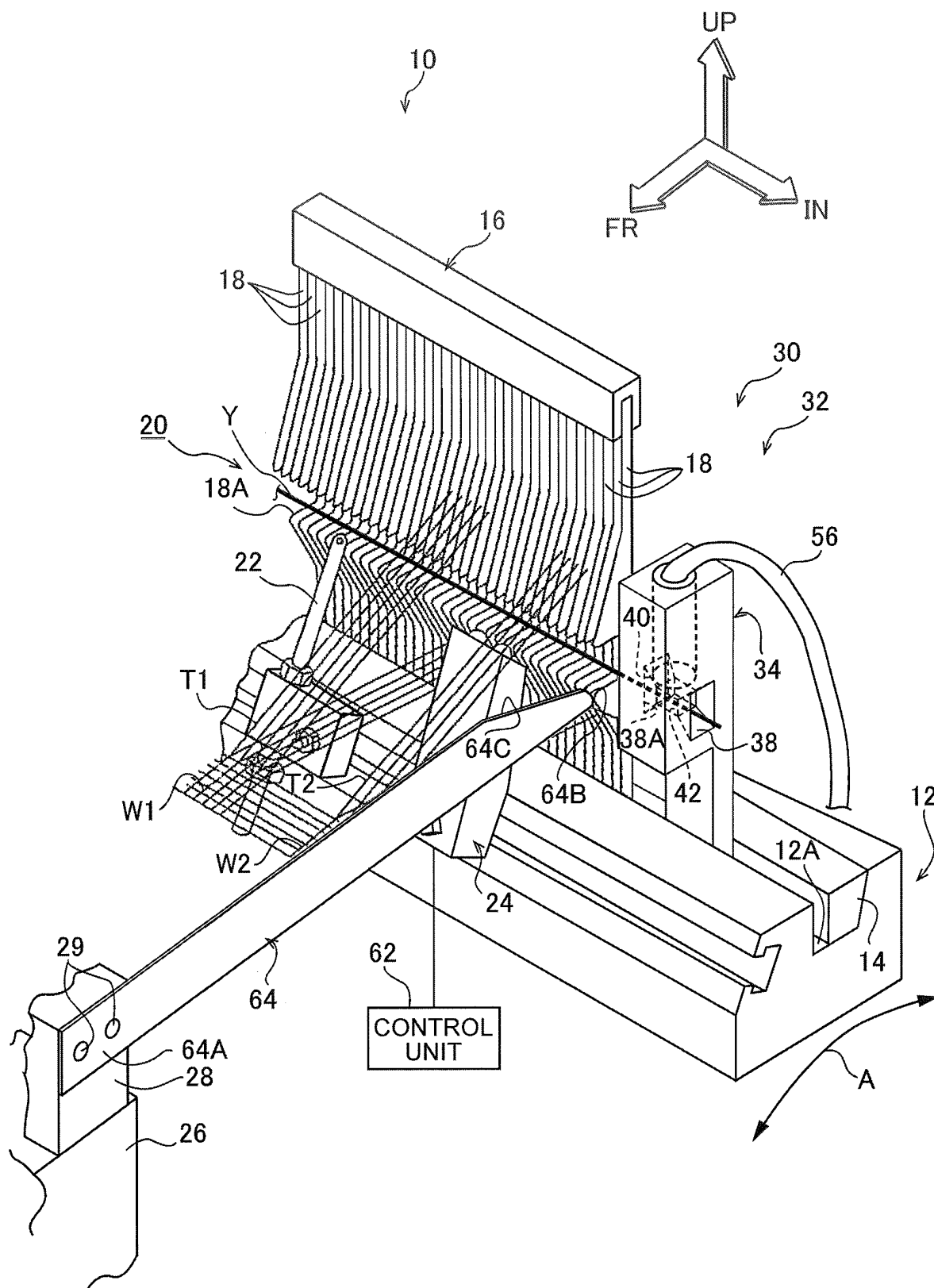


FIG. 2

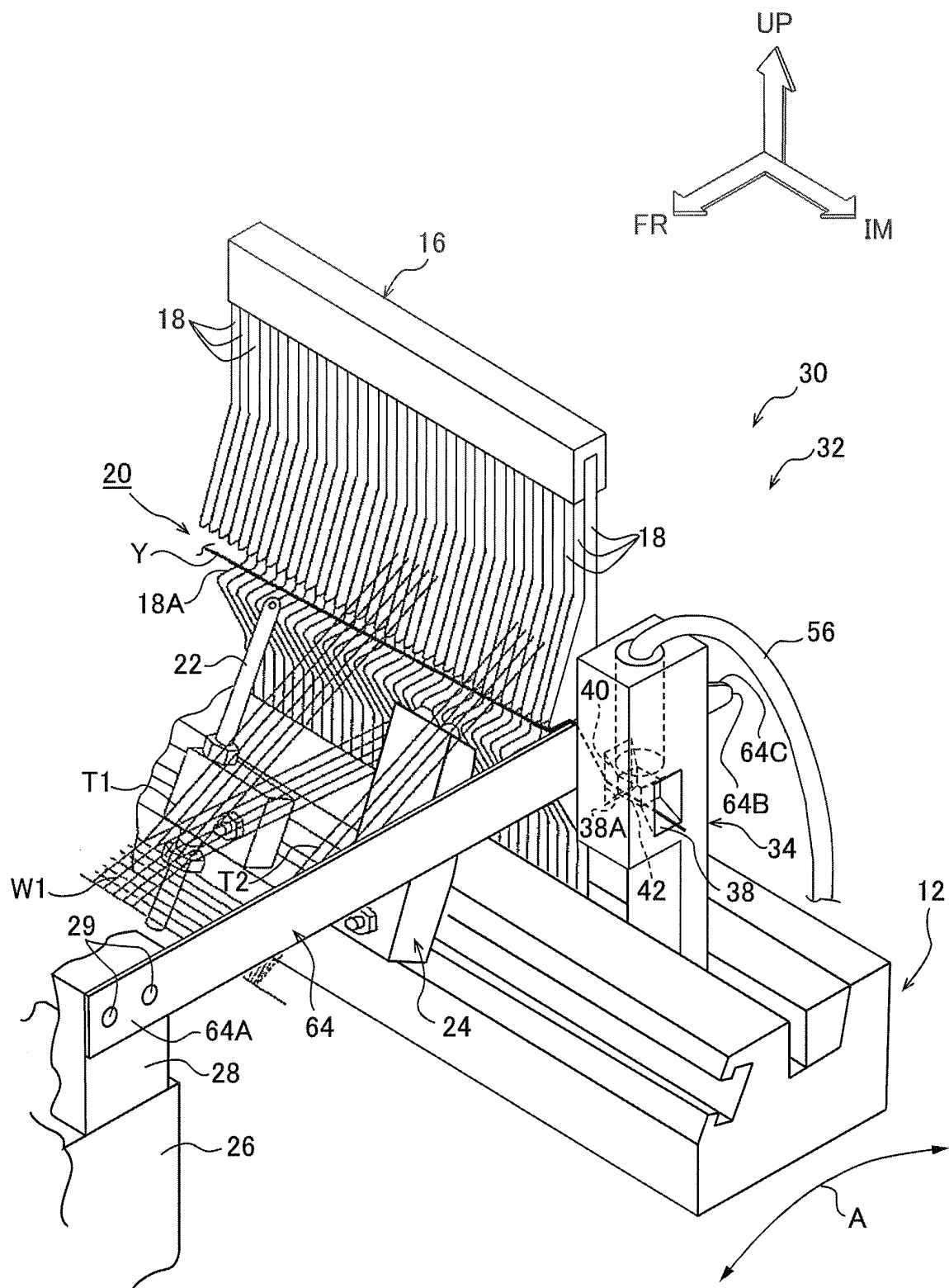


FIG.3

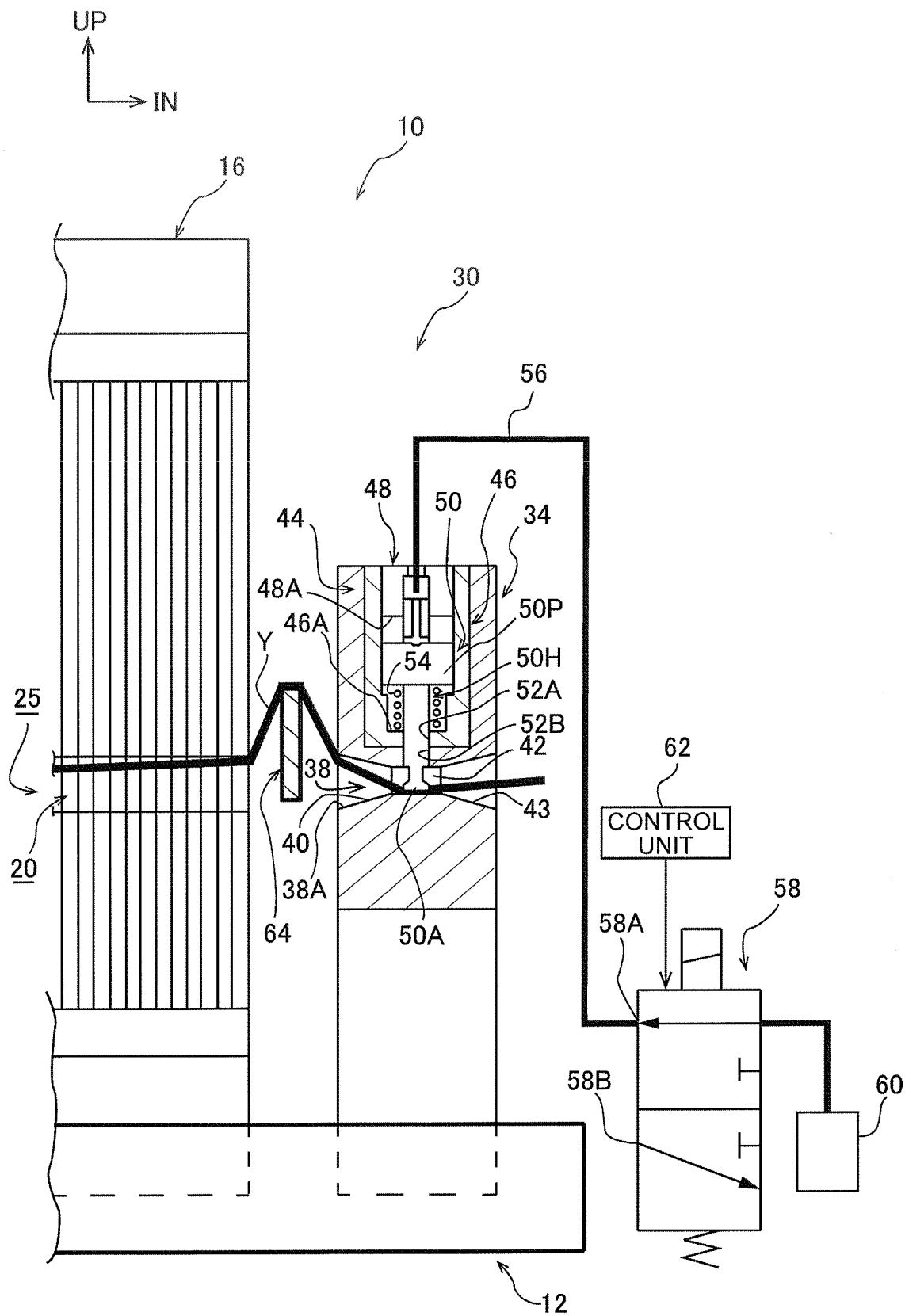


FIG.4A

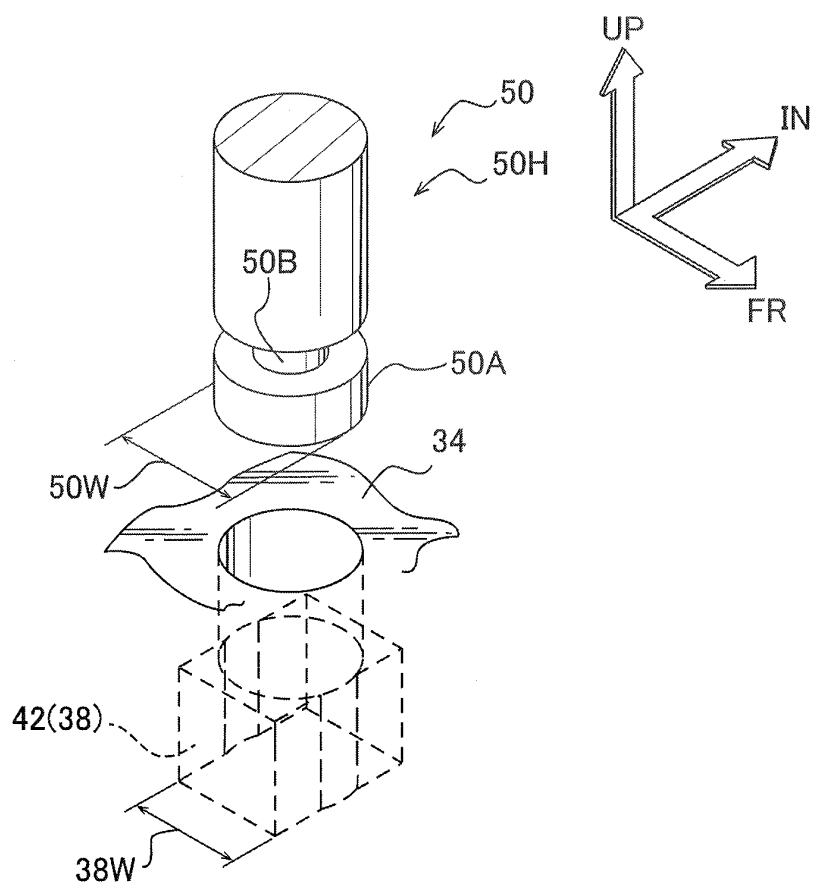


FIG.4B

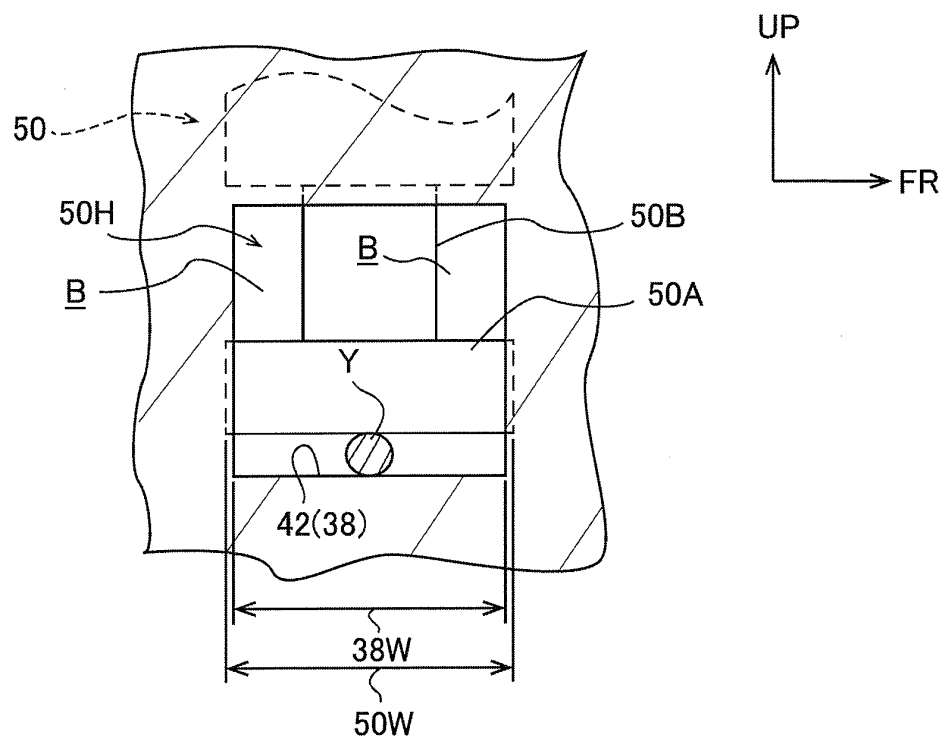


FIG.5

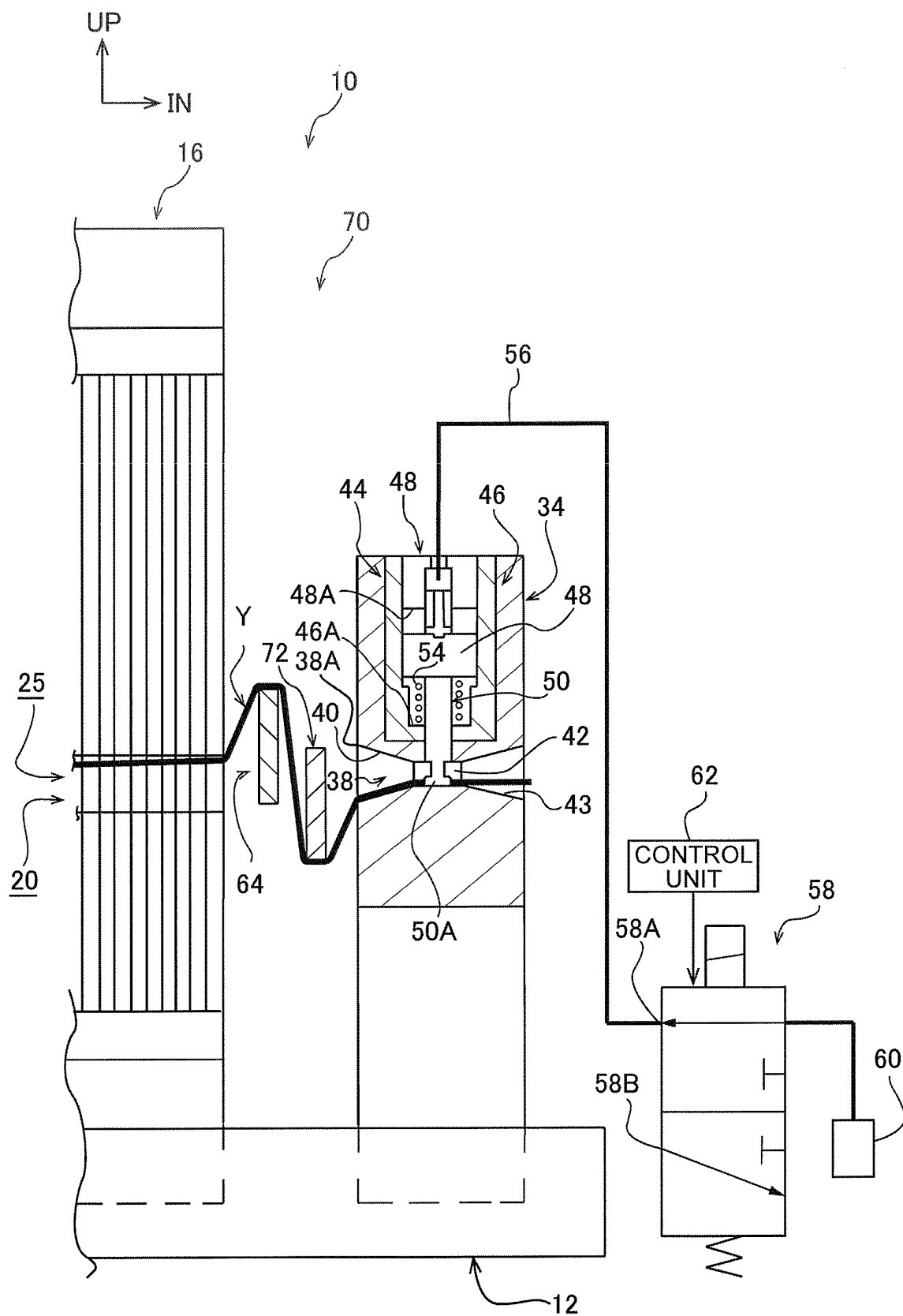


FIG. 6

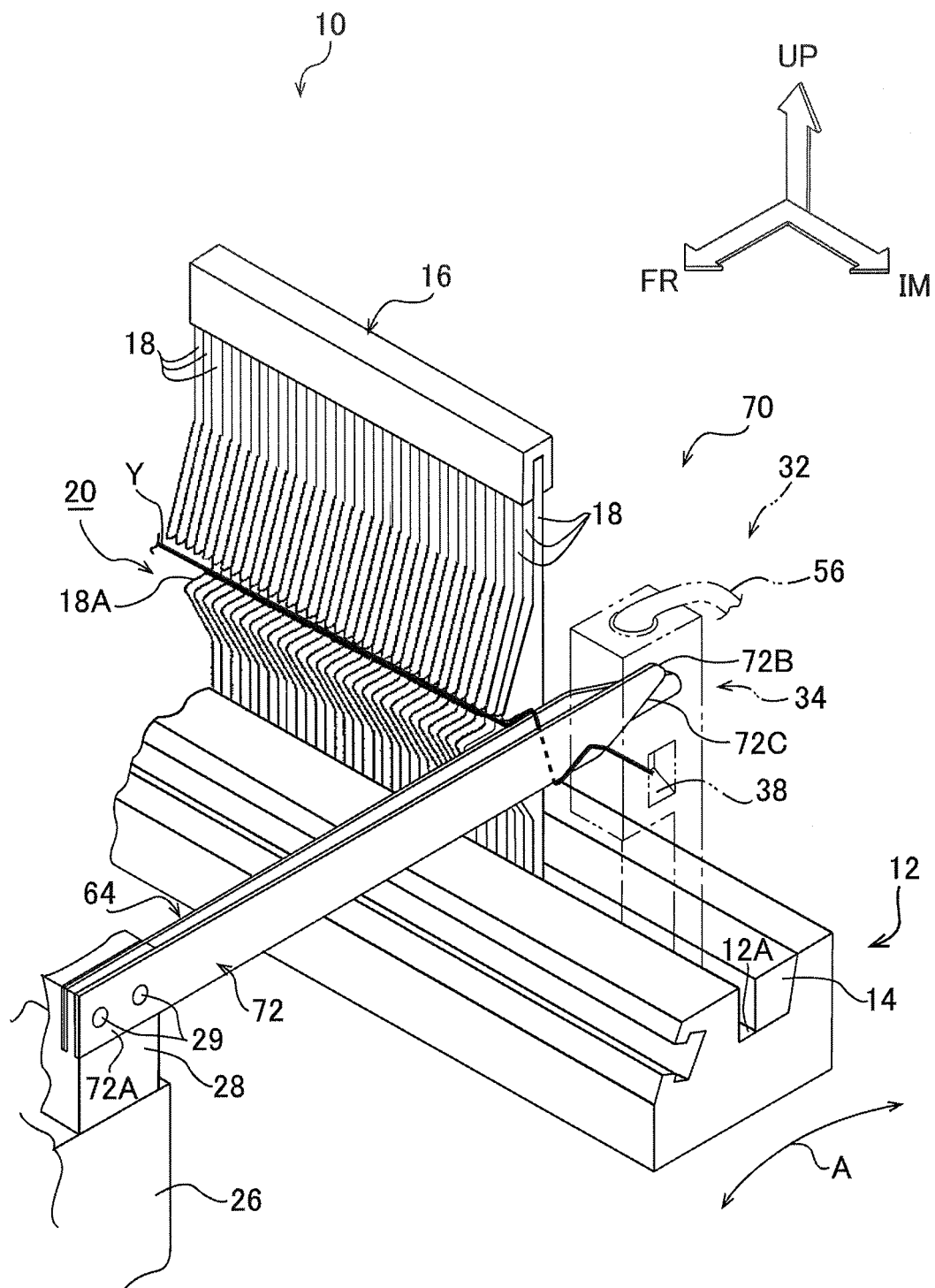


FIG.7

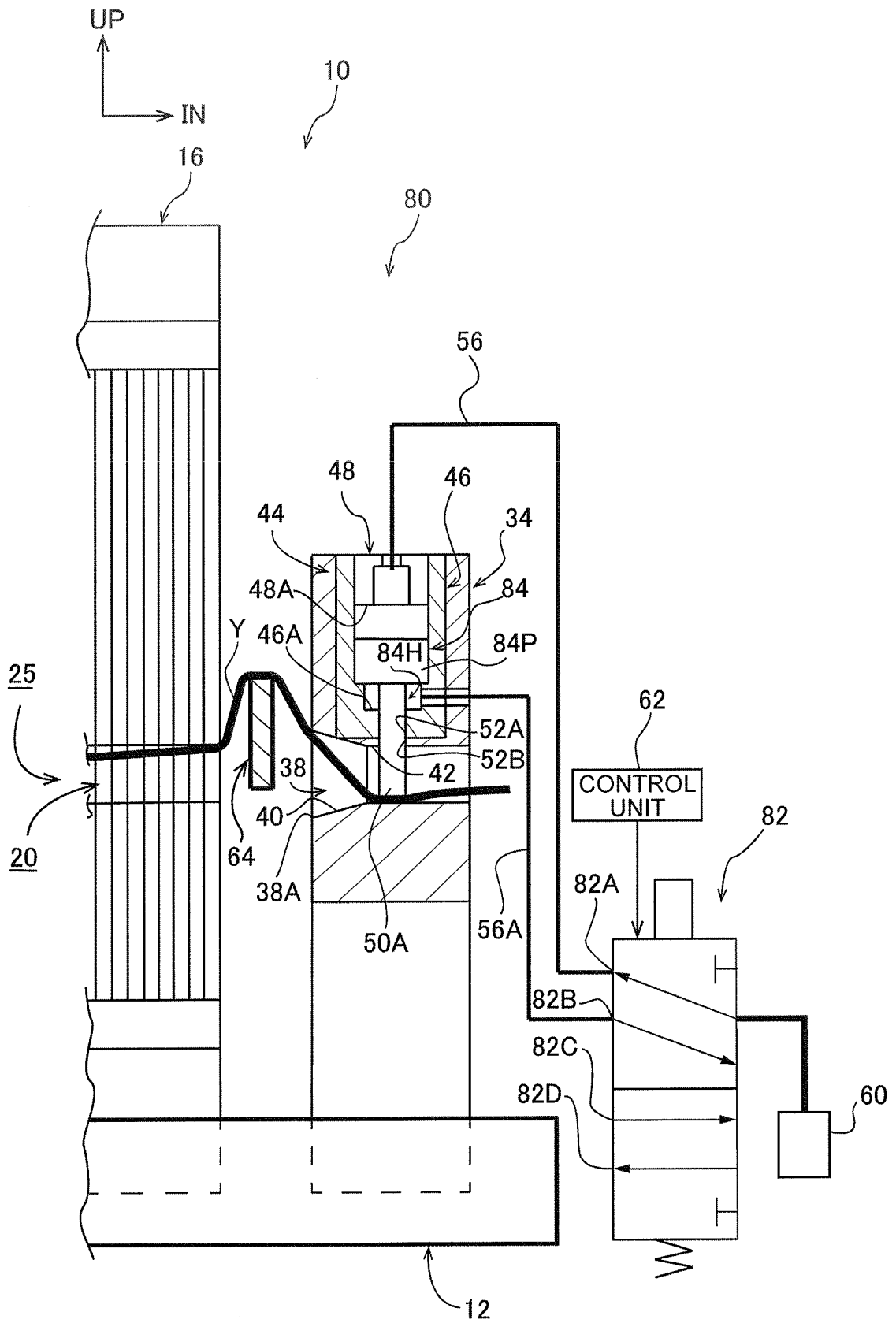


FIG.8

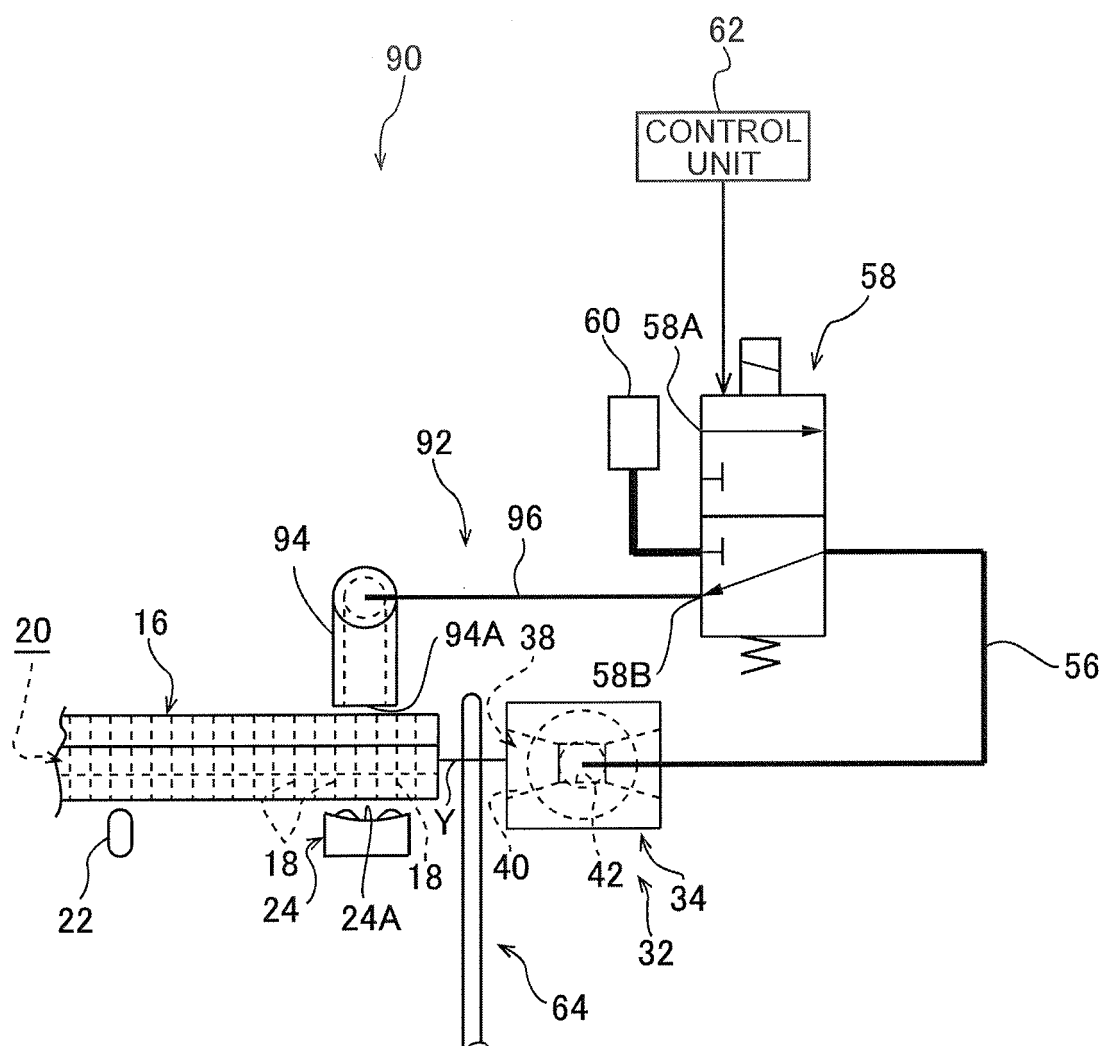


FIG.9

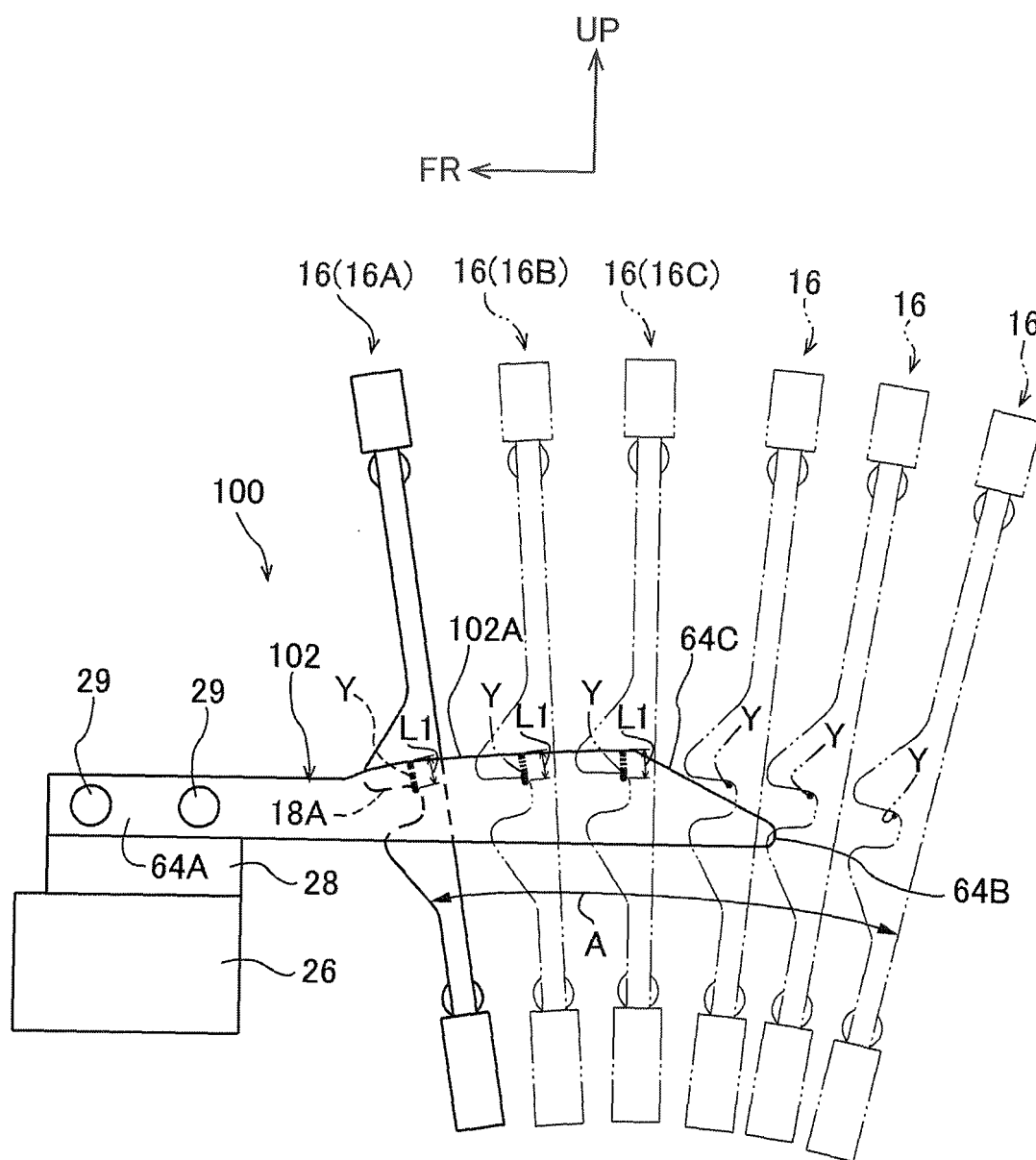


FIG. 10

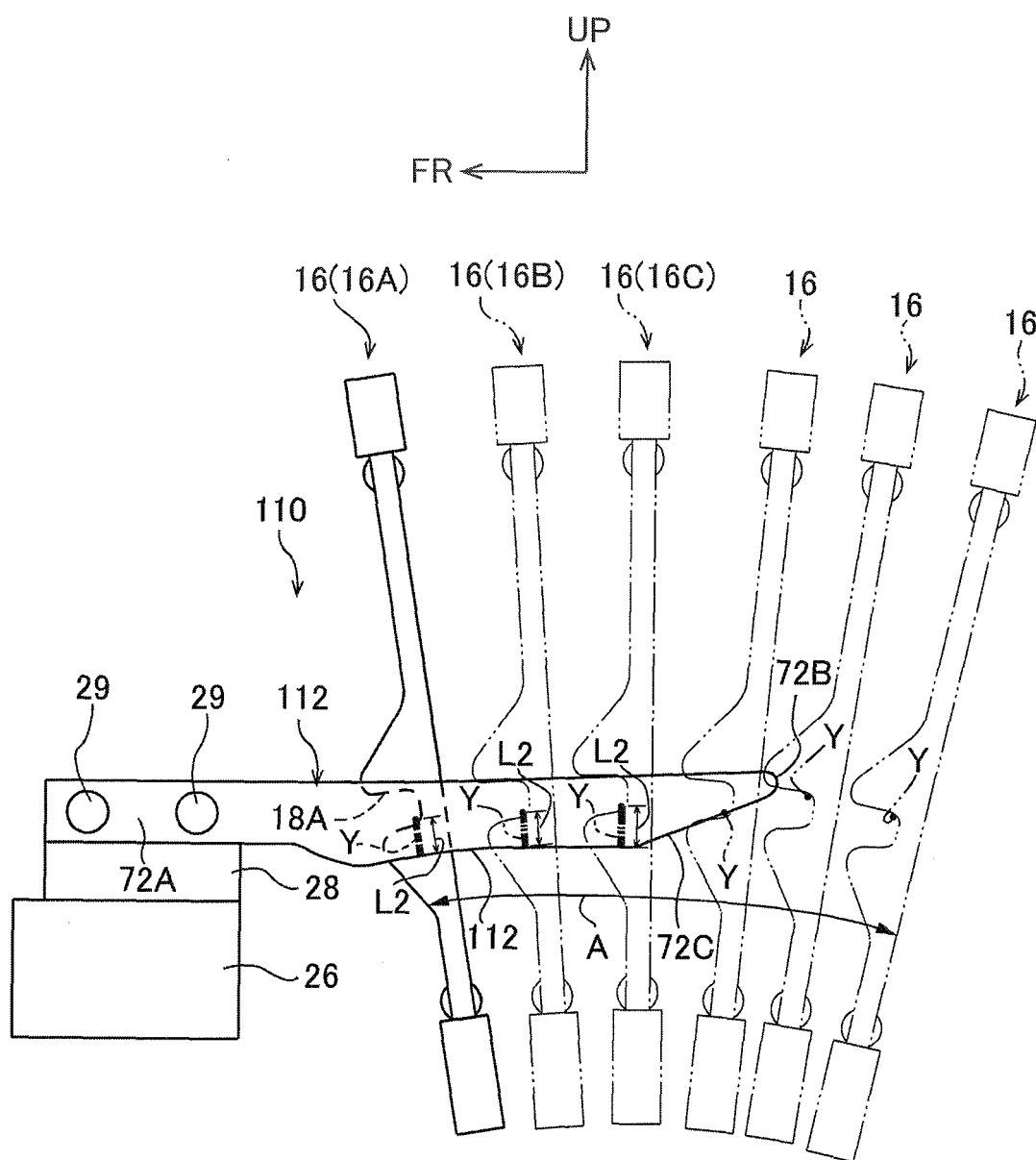


FIG. 11

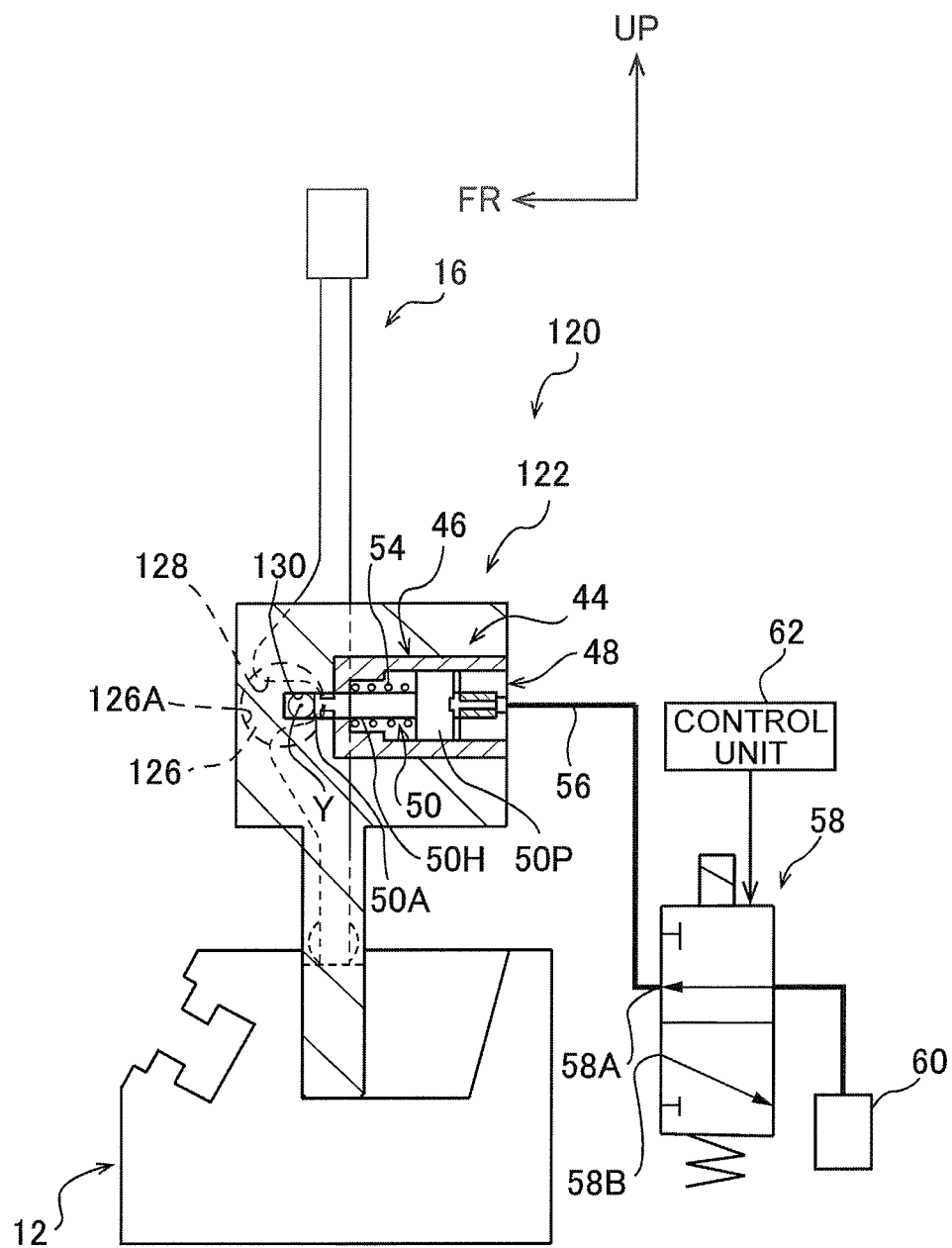


FIG.12

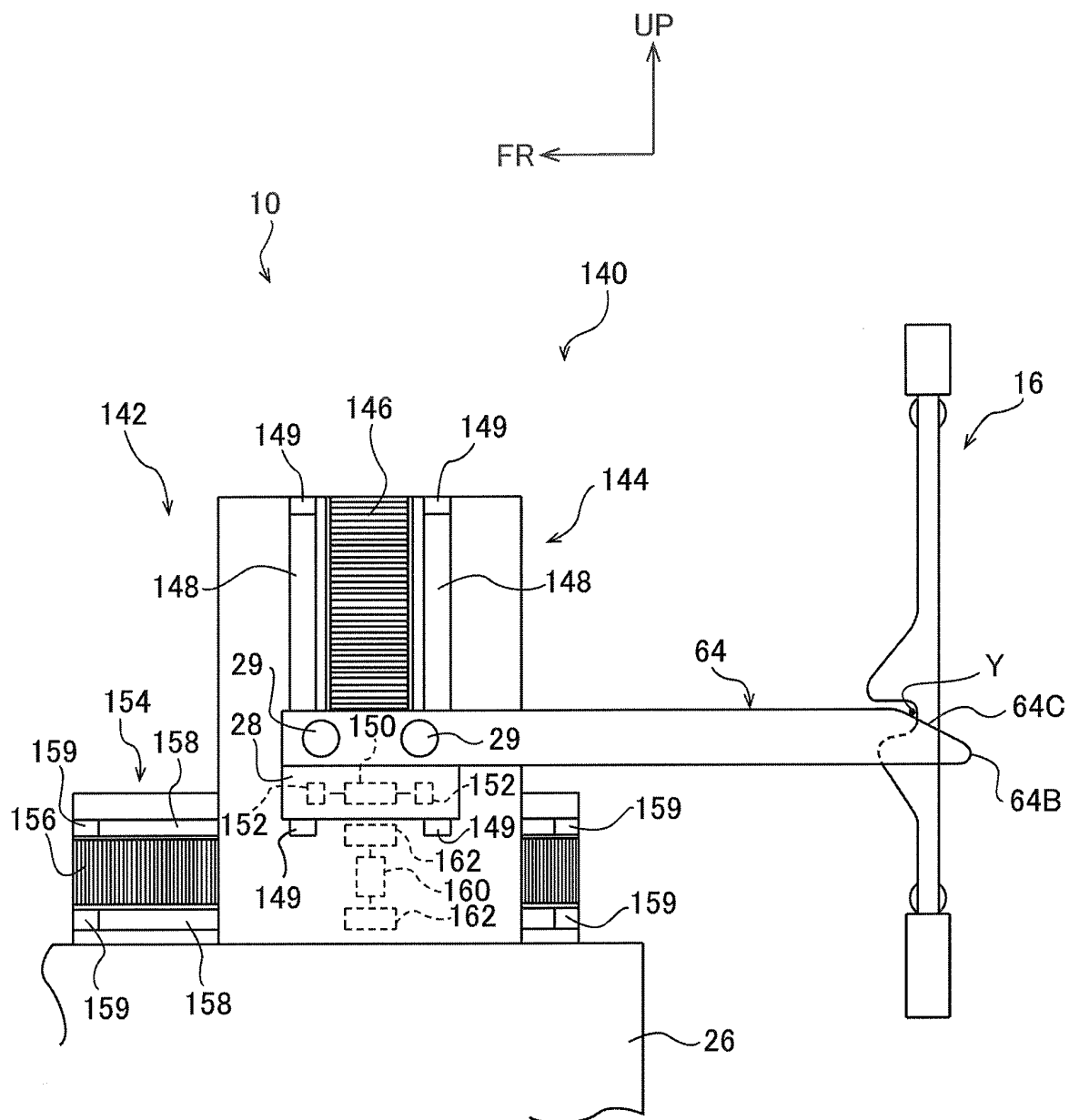


FIG.13

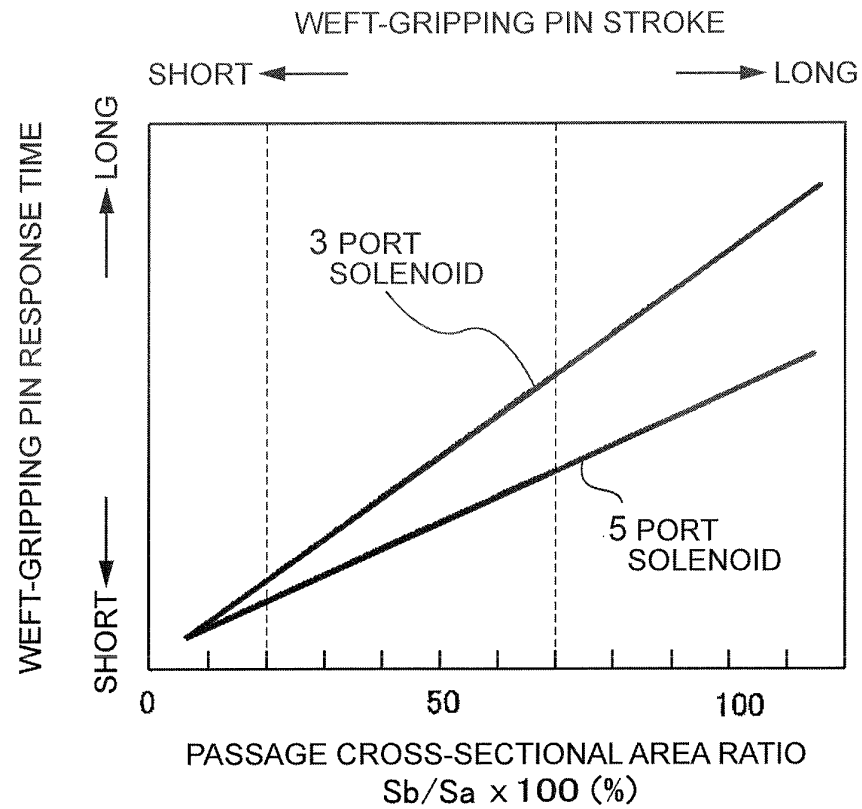


FIG.14

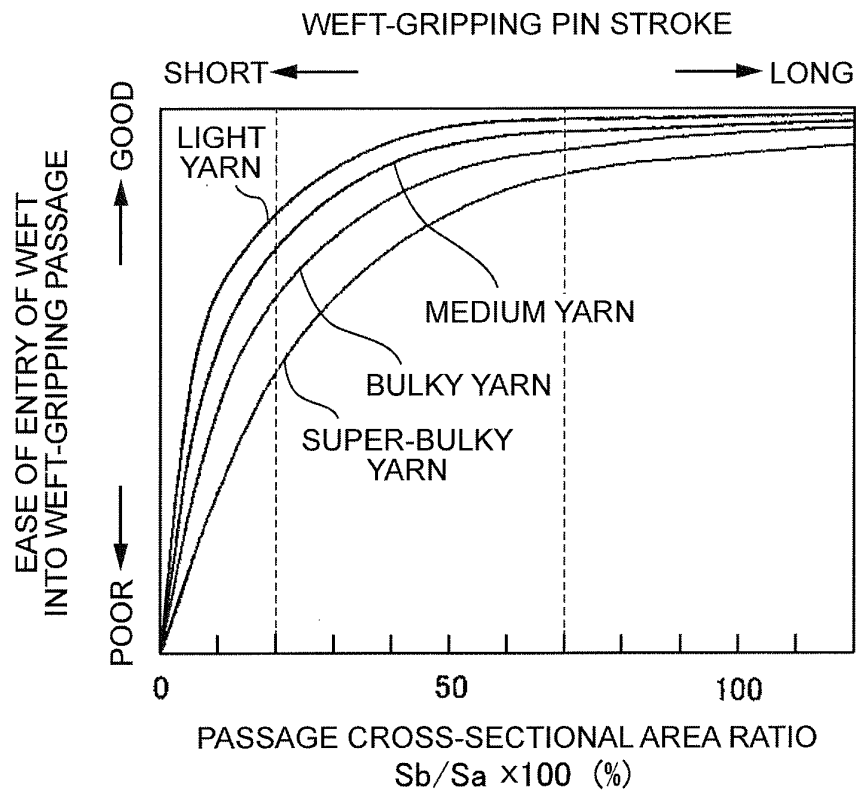


FIG.15A

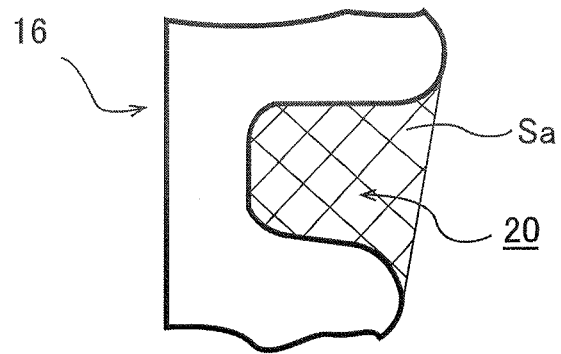


FIG.15B

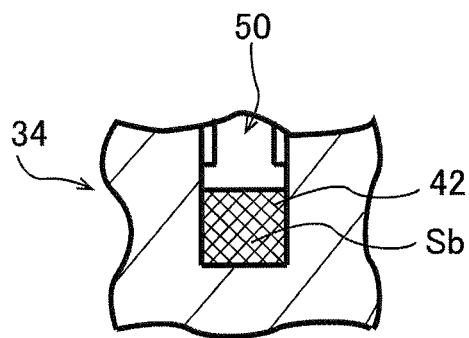


FIG.16

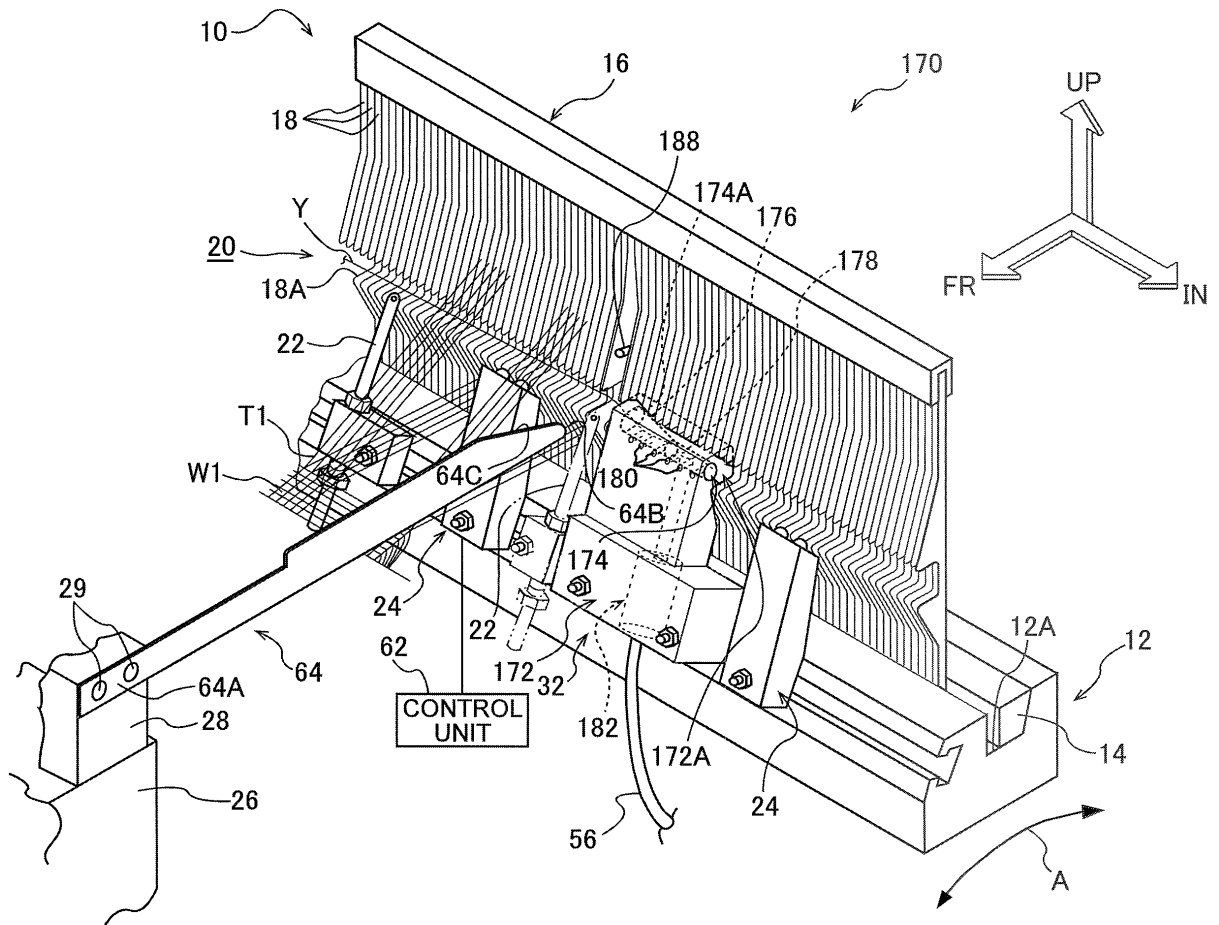


FIG.17

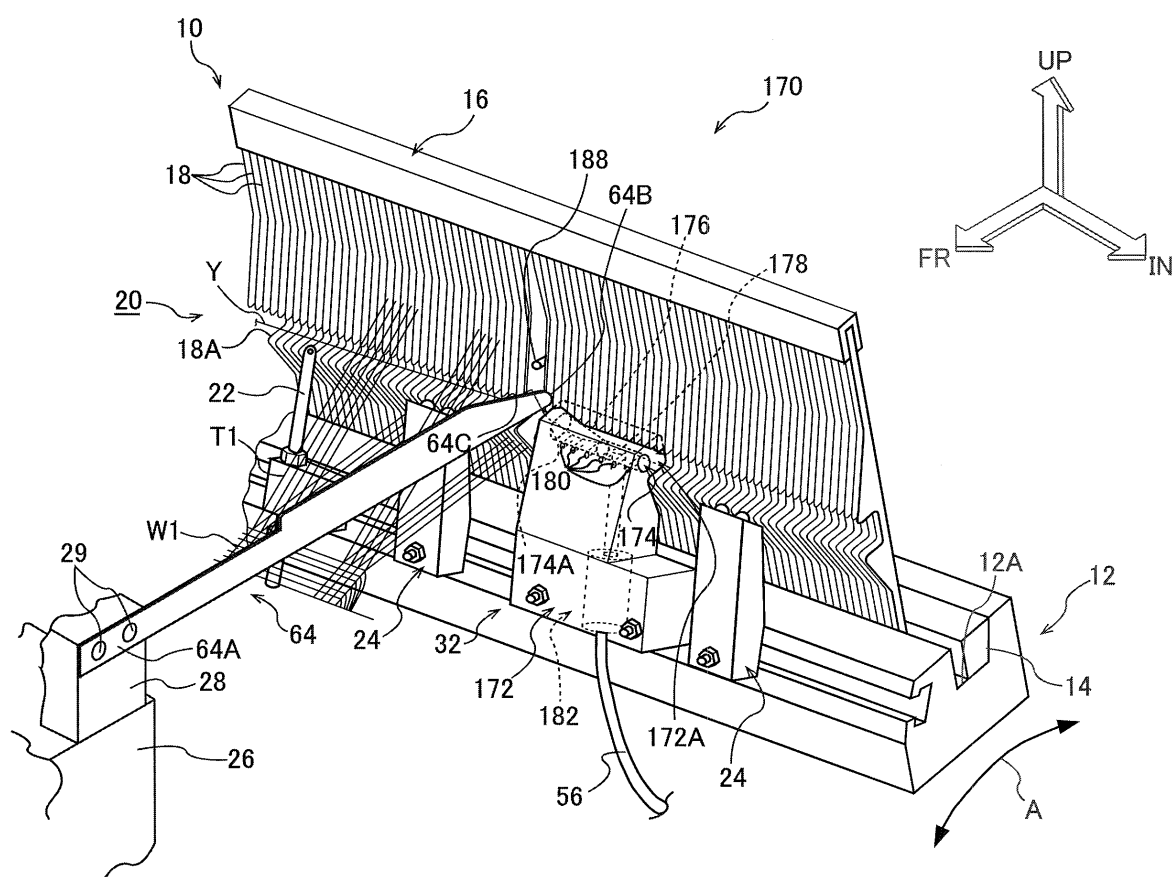


FIG. 18

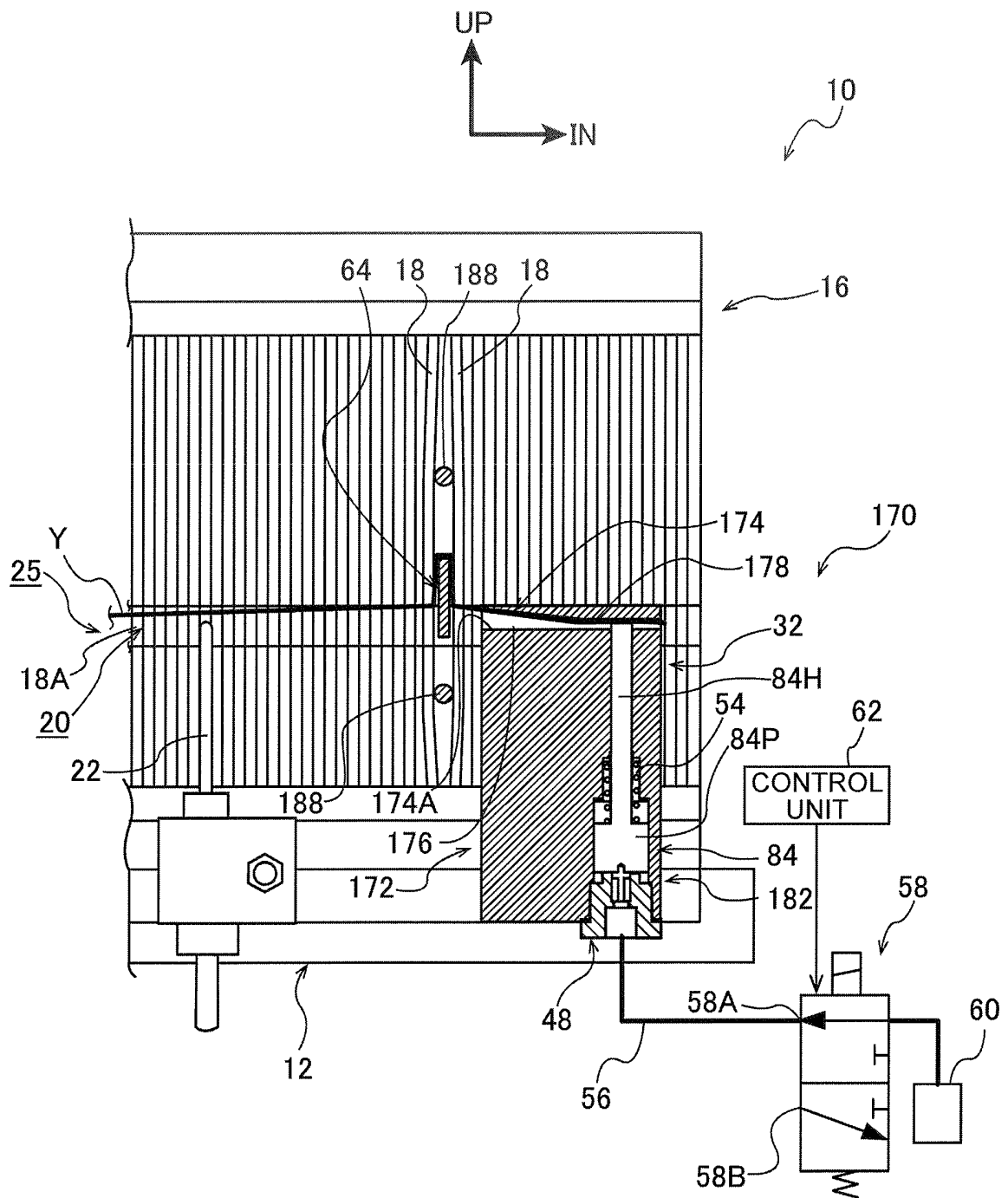


FIG. 19

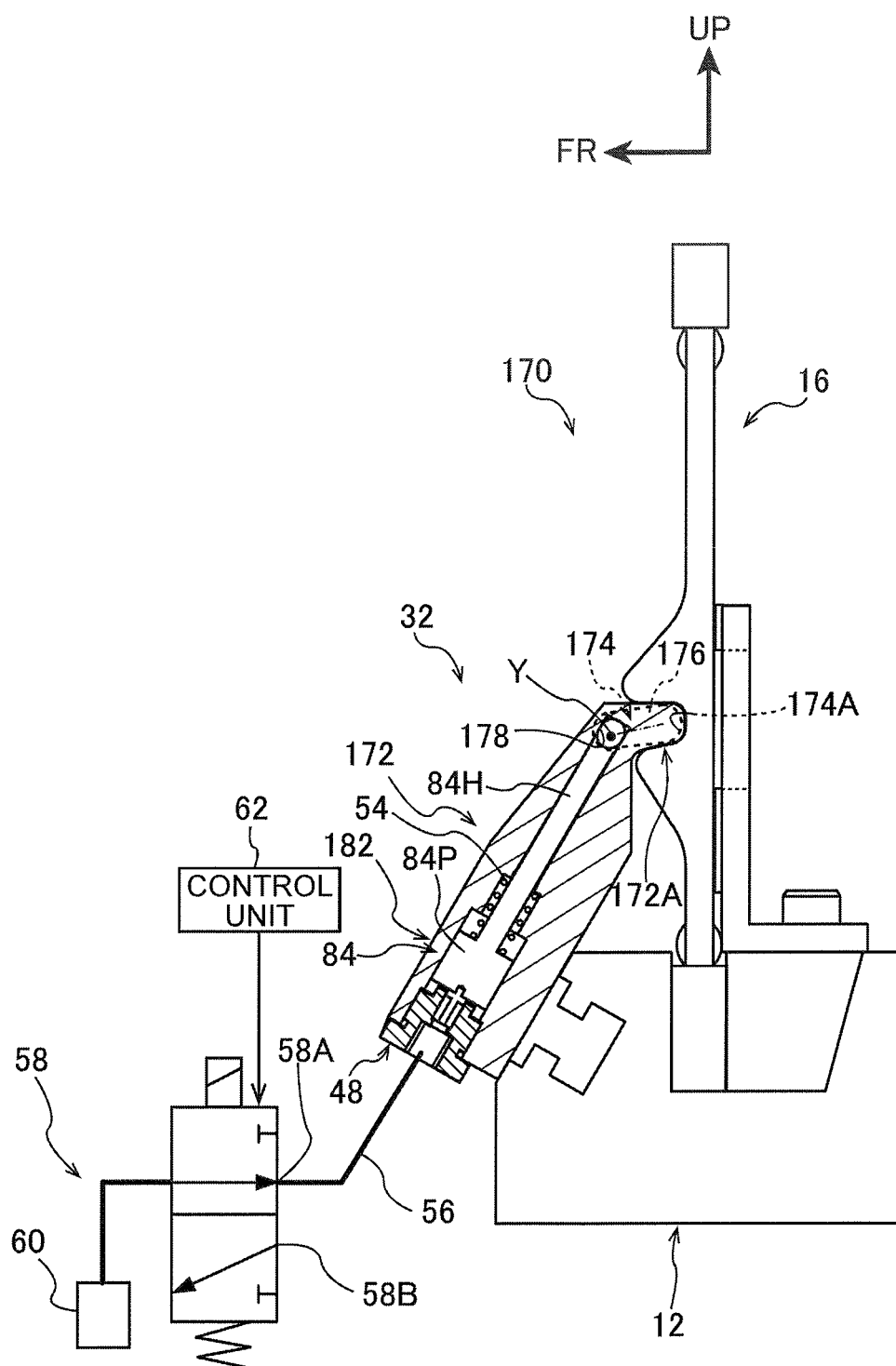


FIG.20

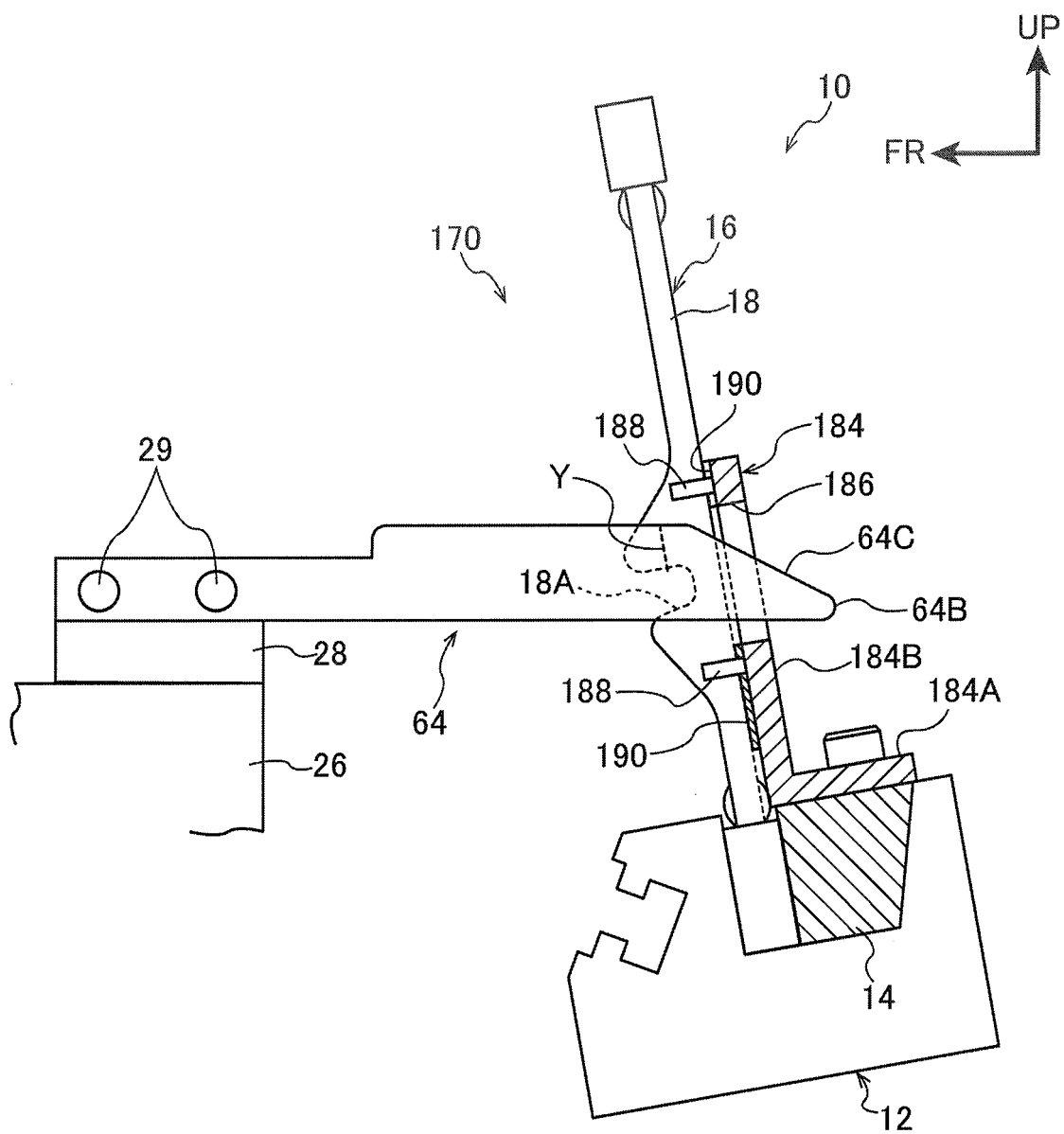
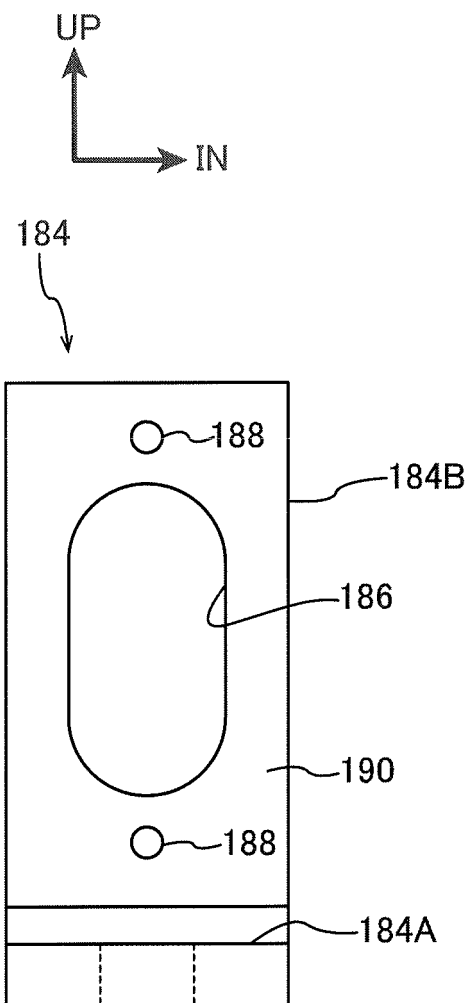


FIG.21



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/052254

A. CLASSIFICATION OF SUBJECT MATTER

D03D47/28 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D03D47/28-47/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012

Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 7-166448 A (Toyoda Automatic Loom Works, Ltd.), 27 June 1995 (27.06.1995), paragraphs [0015] to [0032]; fig. 1 to 9 (Family: none)	1-7, 9, 10 8
Y A	JP 2004-218103 A (Tsudakoma Corp.), 05 August 2004 (05.08.2004), paragraphs [0024] to [0069], [0112]; fig. 1 to 6 & EP 1437431 A2 & CN 1517460 A	1-7, 9, 10 8

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search
04 April, 2012 (04.04.12)Date of mailing of the international search report
17 April, 2012 (17.04.12)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/052254

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2-14046 A (Tagawa Kikai Co., Ltd.), 18 January 1990 (18.01.1990), page 3, lower left column, line 3 to page 5, upper left column, line 14; fig. 1 to 10 & US 4976292 A & DE 3921033 A & FR 2634230 A & IT 1231610 B & KR 10-1991-0006257 B	3-7,9,10
A	JP 2006-510820 A (Picanol N.V.), 30 March 2006 (30.03.2006), entire text; all drawings & US 2006/0151047 A1 & EP 1576219 A & WO 2004/059055 A1 & DE 10261774 A & CN 1729330 A & AU 2003293732 A	1-10

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REFERENCES CITED IN THE DESCRIPTION

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