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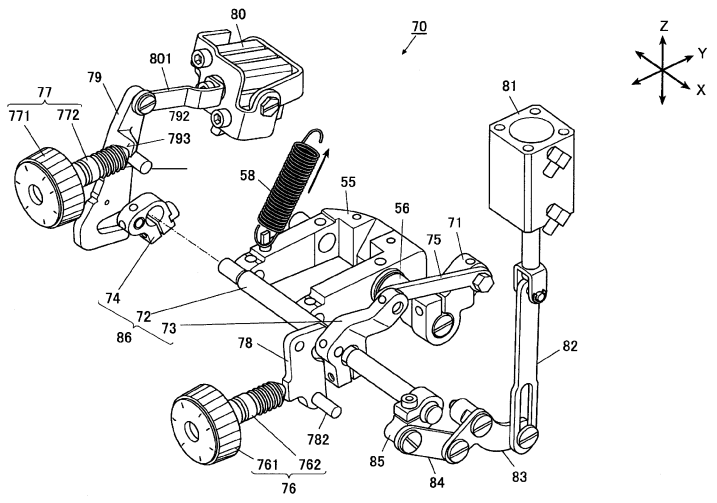
(54) Cloth feed adjusting device of sewing machine

(57) A cloth feed adjusting device of a sewing machine includes a turning unit (86) configured to change a stitch pitch, a cam member (78, 79) configured to change a rotation angle of the turning unit, first and second adjusting members (76, 77) configured to set a rotation angle of the cam member, and a pitch switching actuator (80) configured to switch a contacting state between a cam portion (781,791) and contact portions (731, 741) of the turning unit. The cam portion is formed such that a forward feed adjusting portion (785, 795) for adjusting a forward feeding pitch and a backward feed adjusting portion (786, 796) for adjusting a backward feeding pitch face each other and have a border at an intermediate position (784, 794) at which a stitch pitch becomes 0. The cloth feed adjusting device includes a feed direction switching actuator (81) configured to moves the contact portion between the forward feed adjusting portion and the backward feed adjusting portion to switch a stitch direction, and a control unit (90) configured to drive, at the time of starting the operation of the pitch switching actuator, the feed direction switching actuator in a range in which the stitch direction is not switched.

FIG. 5



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Description

[0001] The present invention relates to a cloth feed adjusting device of a sewing machine including two adjusting members.

[0002] A cloth feeding device of a typical sewing machine includes a feed adjusting body capable of adjusting a motion transmission amount thereof along a pathway through which a feeding motion is transmitted from a cloth feeding driving source to a feed dog. By turning the feed adjusting body to change its angle, it is possible to adjust a stitch pitch (a feeding amount). This feed adjusting body is configured such that, when this feed adjusting body is at a neutral angle, the stitch pitch is 0, and when the feed adjusting body is turned in a given direction from the neutral angle, the stitch pitch in a forward feed direction increases from 0, and when the feed adjusting body is turned in the opposite direction from the neutral angle, the stitch pitch in a backward feed direction increases from 0.

[0003] Further, there is know a cloth feed adjusting mechanism configured to be able to switch between two stitch pitches which are individually set, so as to selectively use the stitch pitch depending on the application of the sewing. For example, the cloth feed adjusting mechanism includes two adjusting members which separately set different stitch pitches in advance corresponding to the different angles of the above-described feed adjusting body, and is configured to be able to switch from a stitch pitch set by one of the feed adjusting members to a stitch pitch set by the other feed adjusting member at the time of switching the stitch pitch.

[0004] For example, Fig. 16 shows a cloth feed adjusting mechanism 100 described in JP 2007-202667 A. The cloth feed adjusting mechanism 100 includes a first adjusting member 101 and a second adjusting member 102 configured to move forward or backward by dialing operations, a first cam member 103 having a lower end supported by a machine frame in a rotatable manner by a pivot 109, receiving a rotational force in a clockwise direction in Fig. 16 by a coil spring 107, and configured to turn when pushed by a tip end portion 101A of the first adjusting member 101, a second cam member 104 having an intermediate portion supported by the machine frame in a rotatable manner by a pivot 110, and is configured to turn when pushed by a tip end portion 102A of the second adjusting member 102, a feed adjusting arm 106 having a single contact pin 105 capable of contacting cam portions 103A, 104A of the first cam member 103 and the second cam member 104, and an action arm 108 coupled to the second cam member 104 to move to the left in Fig. 16 due to an action of an air cylinder (not shown).

[0005] The feed adjusting arm 106 is coupled to a feed adjusting body (not shown) of the feeding device, and when the feed adjusting arm 106 turns, the feed adjusting body also turns in an interlocking manner.

[0006] When the contact pin 105 of the feed adjusting arm 106 contacts the cam portions 103A, 104A of the first and second cam members 103, 104, an angle of the feed adjusting body is determined via the feed adjusting arm 106, and the stitch pitch is adjusted to a stitch pitch corresponding to the contacting positions.

[0007] The cam portions 103A, 104A of the respective cam members 103, 104 are both formed in substantially V shapes in which the both sides of the valley portions are sloping portions, and the valley portions are at intermediate positions which set the feed adjusting body at a neutral position. One of the sloping portions of each the cam portions 103A, 104A is formed such that the stitch pitch in the forward feed direction increases as it separates from the intermediate position, and the other sloping portion of each of the cam portions is formed such that the stitch pitch in the backward feed direction increases as it separates from the intermediate position. When the contact pin 105 moves along the sloping portions on both sides facing each other with the intermediate position interposed therebetween, the feed adjusting body turns in the forward and backward respective directions, to adjust the setting of a stitch pitch.

[0008] Normally, as shown in Fig. 16, the first cam member 103 receives a rotational force in a clockwise direction by the coil spring 107, to contact the first adjusting member 101, and the second cam member 104 retracts so as not to contact the second adjusting member 102. In this state, the cam portion 104A of the second cam member 104 is located on the rear side (on the right side in Fig. 16) than the cam portion 103A of the first cam member 103, so as to separate from the contact pin 105, and the cam portion 103A of the first cam member 103 contacts the contact pin 105, to perform cloth feeding at a stitch pitch set by the first adjusting member 101.

[0009] When a switching button is pressed in this state, the cam portion 104A of the second cam member 104 is located further forward (on the left side in Fig. 16) than the cam portion 103A of the first cam member 103 by an actuation of the air cylinder, and the second cam member 104 is turned in a clockwise direction in Fig. 16 so as to bring the second cam member 104 into contact with the second adjusting member 102. Then, the cam portion 104A of the second cam member 104 engages the contact pin 105, and the stitch pitch set by the first adjusting member 101 is switched to the stitch pitch set by the second adjusting member 102. Then, the mechanism returns to the aforementioned normal condition by stopping the actuation of the air cylinder. Further, this cloth feed adjusting mechanism 100 is further equipped with an air cylinder which receives an operation of the switching button for backward feeding, to turn the contact pin 105 of the feed adjusting arm 106 from the sloping portions on the forward feeding side to the sloping portions on the backward feeding side in the respective cam portions 103A, 104A, thereby switching the feed direction.

[0010] However, in a conventional cloth feed adjusting mechanism of a sewing machine, at the time of switching the stitch pitch in accordance with an actuation or no

actuation of the air cylinder, from the state in which the cam portion 103A (104A) of one of the cam members 103 (and 104) is in contact with the contact pin 105, the other cam member 104 (103) is rotated from when the cam portion 104A (103A) of the other cam member 104 (103) engages the contact pin 105 until the other cam member 104 (103) engages the tip end portion 102A (101A) of the corresponding adjusting member 102 (101). Therefore, the contact pin 105 and the cam portion slide on each other from when the contact pin 105 engages the cam portion of the other cam member until the other cam member engages the tip end portion of the corresponding adjusting member. Accordingly, the air cylinder for switching motion is required to have an output corresponding to the resistance by sliding friction between the contact pin and the cam portion. This is the same also when different actuating means such as an electromagnet is used in place of the air cylinder. Further, because the cam member or the contact pin becomes worn by sliding, and this causes a change in a stitch pitch, an adjustment becomes necessary, thereby leading to a problem that the maintenance efficiency is lowered.

[0011] An object of the present invention is to facilitate a stitch pitch switching operation.

[0012] A cloth feed adjusting device according to an aspect of the present invention includes a first cam member supported by machine frame in a rotatable manner by a first pivot, a second cam member supported by the machine frame in a rotatable manner by a second pivot, a first adjusting member configured to move forward or backward by being operated, and to push the first cam member to regulate a rotational position of the first cam member, a second adjusting member configured to move forward or backward by being operated, and when the second adjusting member contacts the second cam member, the second adjusting member pushes the second cam member to regulate a rotational position of the second cam member, a pitch switching actuator coupled to the second cam member and configured to cause the second cam member to contact or separate from the second adjusting member, and a control unit configured to drive the pitch switching actuator. The first cam member has a first cam portion which is formed such that a first forward feed adjusting portion capable of setting a stitch pitch in a forward feed direction and a first backward feed adjusting portion capable of setting a stitch pitch in a backward feed direction face each other and have a border at an intermediate position at which a stitch pitch becomes 0. The second cam member has a second cam portion which is formed such that a second forward feed adjusting portion capable of setting a stitch pitch in the forward feed direction and a second backward feed adjusting portion capable of setting a stitch pitch in the backward feed direction face each other and have a border at an intermediate position at which a stitch pitch becomes 0. The cloth feed adjusting device further includes a turning unit having a contact portion capable of contacting one of the first cam portion and the second cam portion, and supported so as to be rotatable about one axis with respect to the machine frame to change, in accordance with a rotation angle thereof, the stitch pitch in a range from a forward feeding to a backward feeding, and a feed direction switching actuator configured to rotate the turning unit such that the contact portion moves between the forward feed adjusting portion and the backward feed adjusting portion of one of the first and second cam portions, thereby switching the stitch direction from one of the forward feed direction and the backward feed direction to the other, and at the time of starting the operation of the pitch switching actuator, the control unit drives the feed direction switching actuator in a range in which the stitch direction is not switched.

[0013] A cloth feed adjusting device according to another aspect of the present invention includes a cam member supported by a machine frame in a rotatable manner by a pivot, a first adjusting member configured to move forward or backward when operated, and to push the cam member to regulate a rotational position of the cam member, a second adjusting member configured to move forward or backward when operated, a pitch switching actuator coupled to the cam member, and configured to cause the cam member to contact or separate from the second adjusting member, and a control unit configured to drive the pitch switching actuator. The cam member has a cam portion which is formed such that a forward feed adjusting portion capable of adjusting a stitch pitch in a forward feeding when contacted by the contact portion and a backward feed adjusting portion capable of adjusting a stitch pitch in a backward feeding when contacted by the contact portion face each other and have a border at an intermediate position at which a stitch pitch becomes 0. The cloth feed adjusting device further includes a turning unit having a contact portion capable of contacting the cam portion, and supported so as to be rotatable about one axis with respect to the machine frame to change, in accordance with a rotation angle thereof, the stitch pitch in a range from the forward feeding to the backward feeding, and a feed direction switching actuator configured to rotate the turning unit such that the contact portion moves between the forward feed adjusting portion and the backward feed adjusting portion of the cam portion, thereby switching the stitch direction from one of the forward feed direction and the backward feed direction to the other, and at the time of starting the operation of the pitch switching actuator, the control unit drives the feed direction switching actuator in a range in which the stitch direction is not switched.

[0014] The cloth feed adjusting device may further include detecting means for detecting a predetermined operation amount of the feed direction switching actuator, and the control unit may perform the operation of the feed direction switching actuator at the time of starting the operation of the pitch switching actuator until the detecting means detects the predetermined operation amount.

[0015] The cloth feed adjusting device may further include clocking means for measuring an operation time

of the feed direction switching actuator, and the control unit may perform the operation of the feed direction switching actuator at the time of starting the operation of the pitch switching actuator until the clocking means measures a predetermined operation time.

[0016] In the case of a configuration in which two different stitch pitches are set by using the first and second cam members, first, the first and second adjusting members are operated, to determine the respective forward and backward positions. At this time, the first cam member is in contact with the first adjusting member, and the second cam member is spaced away from the second adjusting member.

[0017] When switching to a stitch pitch set by the second adjusting member from a state in which a stitch pitch set by the first adjusting member is selected, the feed direction switching actuator is, simultaneously with the pitch switching actuator, driven in a range in which the stitch direction is not switched. As a result, the contact portion moves from one of the forward feed adjusting portion and the backward feed adjusting portion to the other. Because the pitch switching actuator performs the operation of switching of the cam members at that time, sliding contact between the contact portion and the cam portion of the second cam member is avoided or reduced. Accordingly, sliding friction is reduced, and it becomes possible for even a small pitch switching actuator having a small output to easily perform a stitch pitch switching operation.

[0018] Further, due to a reduction in sliding friction, it becomes possible to more quickly perform a stitch pitch switching operation.

[0019] Moreover, due to a reduction in sliding friction, it becomes possible to reduce wear between the contact portion and the cam portion, which makes it possible to improve durability and maintenance efficiency.

[0020] In the case of a configuration in which two different stitch pitches are set by using one cam member, first, the first and second adjusting members are operated to determine the respective forward and backward positions. At this time, the cam member contacts the first adjusting member, and is spaced away from the second adjusting member.

[0021] When switching the stitch pitch to a stitch pitch set by the second adjusting member from a state in which a stitch pitch set by the first adjusting member is selected, the feed direction switching actuator is, simultaneously with the pitch switching actuator, driven in a range in which the stitch direction is not switched. As a result, in the cam portion of the cam member, the contact portion moves from one of the forward feed adjusting portion and the backward feed adjusting portion to the other. Because the pitch switching actuator turns the cam member to switch the contact position between the contact portion and the cam portion at that time, sliding contact between the contact portion and the cam portion is avoided or reduced. Accordingly, sliding friction is reduced, and the load on the pitch switching actuator is reduced, which makes it possible to use a small pitch switching actuator having a small output.

[0022] Further, due to a reduction in sliding friction, it becomes possible to more quickly perform a stitch pitch switching operation.

[0023] Moreover, due to a reduction in sliding friction, it becomes possible to reduce wear between the contact portion and the cam portion, which makes it possible to improve durability and maintenance efficiency.

[0024] Further, in the case of a configuration in which detecting means for detecting a predetermined operation amount of the feed direction switching actuator is included, an appropriate operation amount of the pitch switching actuator is detected by the detecting means, and it is possible to perform a more secure motion, which makes it possible to improve reliability of the mechanism.

[0025] Further, in the case of a configuration in which clocking means for measuring an operation time of the feed direction switching actuator is included, an appropriate motion timing of the pitch switching actuator is detected by the clocking means, and it is possible to perform a more secure motion, which makes it possible to improve reliability of the mechanism.

[0026] The following description of embodiments of the present invention describes the present invention in greater detail along with the drawings. The drawings include:

- Fig. 1: a plan view showing a configuration inside a bed portion of a sewing machine;
- Fig. 2: a cross sectional view taken along V-V in Fig. 1;
- Fig. 3: a cross sectional view taken along W-W in Fig. 1;
- Fig. 4: a perspective view of a transmission mechanism;
- Fig. 5: a perspective view of a cloth feed adjusting mechanism;
- Fig. 6A: a motion explanatory diagram of a first cam member where a contact pin is at an intermediate position, viewed from the Y-axis direction;
- Fig. 6B: a motion explanatory diagram of the first cam member setting a stitch pitch in a forward feed direction, viewed from the Y-axis direction;
- Fig. 7A: a motion explanatory diagram of a second cam member retracting from a second adjusting member, viewed from the Y-axis direction;
- Fig. 7B: a motion explanatory diagram of the second cam member in contact with the second adjusting member, viewed from the Y-axis direction;
- Fig. 8A: an explanatory diagram illustrating the stopped state of a direction switching cylinder;
- Fig. 8B: an explanatory diagram illustrating an actuating state in a slight operation amount of the

direction switching cylinder;

Fig. 9: a block diagram of a control system of the sewing machine;

Fig. 10: a timing chart in pitch switching control;

Fig. 11: a perspective view of another example of a cloth feed adjusting mechanism;

Fig. 12: an exploded perspective view of the cloth feed adjusting mechanism of Fig. 11;

Fig. 13: a side view of a cam member of the cloth feed adjusting mechanism of Fig. 11;

Fig. 14: an exploded perspective view of the transmission mechanism;

Fig. 15: a motion explanatory diagram of another example of the transmission mechanism; and

Fig. 16: a side view of a conventional cloth feed adjusting mechanism.

[0027] First Embodiment

[0028] Hereinafter, a sewing machine including a cloth feed adjusting device according to a first embodiment of the present invention will be described in detail with reference to Figs. 1 to 9.

[0029] Sewing Machine Frame

[0030] A sewing machine 10 includes a sewing machine frame 20 (machine frame) which is composed of a bed portion 21 having a bed surface horizontally extending so as to be flat and slender, a vertical drum portion 22 installed upright and upward from one end portion in a longitudinal direction of the sewing machine bed portion 21, and an arm portion (not shown) extending in the same direction so as to face the upper side of the bed portion 21 from the upper end portion of the vertical drum portion 22.

[0031] In the following description, the longitudinal direction of the bed portion 21 is defined as the Y-axis direction, the horizontal direction perpendicular to the Y-axis direction is defined as the X-axis direction, and the vertical direction perpendicular to the X-axis direction and the Y-axis direction is defined as the Z-axis direction.

[0032] Throat Plate and Cloth Presser

[0033] As shown in Fig. 3, a throat plate 11 in which an eye through which a sewing needle is inserted, and a through hole 11a from and into which a feed dog 41 of the feeding device 40 which will be described later comes out and gets back are formed, is provided on the top surface of the bed portion 21, and a cloth presser 19 which is supported by a cloth presser bar 18 is disposed at a position immediately above the eye and the through hole 11a of the throat plate 11.

[0034] Sewing Machine Motor and Transmission Mechanism

[0035] As shown in Fig. 2, an upper shaft 12 is installed along the Y-axis direction in the arm portion, and is coupled to a sewing machine motor 16 (Fig. 9) provided outside the arm portion, to be driven to rotate. The upper shaft 12 gives an up-down movement to a needle bar which holds the sewing needle with its lower end portion, via a crank mechanism (not shown). Further, a geared pulley 14 is fixedly mounted to the end portion on the vertical drum portion 22 side, and a timing belt 13 for transmitting rotary drive force to a up-down feed shaft 43 of the feeding device 40 is placed around the pulley 14.

[0036] The sewing machine motor 16 may be coupled to the upper shaft 12 via a coupling, or may transmit torque via a transmission mechanism such as gears.

[0037] Shuttle Mechanism

[0038] As shown in Figs. 1 to 3, a shuttle mechanism 30 includes a shuttle shaft 32 supported rotatably so as to be along the Y-axis direction in the bed portion 21. The shuttle shaft 32 holds a well-known full rotary shuttle 31 at one end portion, and is coupled to the up-down feed shaft 43 via a gear mechanism 60 at the opposite end portion, to be driven to rotate.

[0039] Gear Mechanism

[0040] The gear mechanism 60 includes a drive gear 61 fixedly mounted to the up-down feed shaft 43 and a driven gear 62 fixedly mounted to the shuttle shaft 32, to mesh with the drive gear 61. The number of gear teeth of the drive gear 61 is twice as many as the number of gear teeth of the driven gear 62.

[0041] Feeding Device

As shown in Figs. 2 and 3, the feeding device 40 includes a feed base 42 which fixedly holds the feed dog 41 at an intermediate portion in the longitudinal direction, an up-down feeding mechanism which reciprocates the feed base 42 in the vertical direction (Z-axis direction) by rotation of the up-down feed shaft 43, and a horizontal feeding mechanism which reciprocates the feed base 42 in a feed direction (X-axis direction) along the horizontal direction by rotation of the up-down feed shaft 43.

[0042] The up-down feeding mechanism includes the up-down feed shaft 43 which is supported rotatably along the Y-axis direction in the bed portion 21, an eccentric cam 44 which is fixed to the up-down feed shaft 43, and a crank rod 45 which fits into the eccentric cam 44, and converts the rotation of the up-down feed shaft 43 into reciprocating drive force in the vertical direction, to transmit the force to the feed base 42.

[0043] The up-down feed shaft 43 is disposed along the Y-axis direction in the bed portion 21, and supported rotatably by the machine frame. A geared pulley 15 around which the timing belt 13 is placed is fixed to one end portion of the vertical drum portion 22 side of the up-down feed shaft 43. The pulley 15 has the same number of gear teeth as that of the pulley 14 of the upper shaft which is mentioned above. That is, the pulley 14 and the pulley 15 rotate at a constant speed.

[0044] Further, the crank rod 45 whose one end portion fits into the eccentric cam 44 is coupled rotatably to one end portion of the feed base 42 with the other end portion thereof, and reciprocates the one end portion of the feed base 42 in the vertical direction at a stroke twice as much as an eccentric amount thereof by the eccentric cam 44 when the up-down feed shaft 43 is fully rotated.

[0045] The horizontal feeding mechanism that reciprocates the feed base 42 along the feed direction (X-axis

direction) is disposed in parallel with the up-down feed shaft 43, and supported rotatably by the machine frame. The horizontal feeding mechanism includes a horizontal feed shaft 46 which interlocks with the up-down feed shaft 43, to turn in a reciprocating manner, a horizontal feed arm 47 which converts reciprocation-turning drive force of the horizontal feed shaft 46 into reciprocating drive force in the feed direction, to transmit the force to the feed base 42, and a transmission mechanism 48 which converts rotary drive force of the up-down feed shaft 43 into reciprocation-turning drive force, to transmit the force to the horizontal feed shaft 46.

[0046] Due to the motions of these up-down feeding mechanism and the horizontal feeding mechanism, a cloth intermittent feed motion in units of a predetermined stitch pitch by a well-known feeding movement (elliptic movement) is made with respect to the feed dog 41.

[0047] The transmission mechanism 48 will be described on the basis of Figs. 1, 2, and 4.

[0048] The transmission mechanism 48 includes an eccentric cam 49 fixed to the up-down feed shaft 43, a crank rod 50 whose one end portion is coupled to the up-down feed shaft 43 via the eccentric cam 49, an oscillating arm 51 which is fixed to the horizontal shaft 46, and a feeding amount variable portion 52 which couples the other end portion of the crank rod 50 and the oscillation end portion of the oscillating arm 51, and is capable of adjusting a width of a reciprocation-turning angle transmitted to the horizontal feed shaft 46.

[0049] The crank rod 50 is disposed such that the longitudinal direction thereof is substantially along the X-axis direction, and its base end portion rotatably fits into the eccentric cam 49, and its tip end portion is coupled to the feeding amount variable portion 52. When the up-down feed shaft 43 is fully rotated, the tip end portion of the crank rod 50 performs a reciprocating motion along the longitudinal direction at a stroke twice as much as an eccentric amount thereof by the eccentric cam 49. This reciprocating motion of the crank rod 50 is transmitted as reciprocation-turning drive force to the horizontal feed shaft 46 via the feeding amount variable portion 52 and the oscillating arm 51.

[0050] With respect to the feeding amount variable portion 52, as shown in Fig. 4, a substantially U-shaped feed adjusting body 55 is supported rotatably with respect to the sewing machine frame by a pivot 56 parallel to the horizontal shaft 46, and one ends of a pair of second link bodies 54 and 54 are supported rotatably by a pair of pivots 57A and 57B, at the both tip end portions of the feed adjusting body 55.

[0051] The other ends of the pair of second link bodies 54 and 54 are coupled to and supported rotatably by a pivot 59 to which the tip end of the crank rod 50 is coupled rotatably. Moreover, the lower ends of a pair of first link bodies 53 are supported rotatably by the pivot 59, and the upper ends of the pair of first link bodies 53 are coupled rotatably to the tip end of the oscillating arm 51. The pivots 57A, 57B, and 59 are respectively parallel to the horizontal feed shaft 46.

[0052] Accordingly, the feeding amount variable portion 52 includes the pair of first link bodies 53 which are coupled to the tip end portion of the crank rod 50 and the tip end portion of the oscillating arm 51, the pair of second link bodies 54 which guides a reciprocating motion direction of the other end portion of the crank rod 50 to any direction, and the feed adjusting body 55 which adjusts a guiding direction by the second link bodies 54.

[0053] In the feeding amount variable portion 52, when the feed adjusting body 55 is rotated to an angular position (a neutral position) at which the first link bodies 53 and the second link bodies 54 are overlapped in parallel, the drive force of the crank rod 50 is not transmitted to the oscillating arm 51, so as not to transmit the reciprocation-turning motion to the horizontal feed shaft 46, thereby making a stitch pitch 0.

[0054] When the feed adjusting body 55 is turned in one direction from the neutral angle, a reciprocating oscillating motion is given to the oscillating arm 51 side according to its turning angle amount, thereby it is possible to widen a stitch pitch in the forward feed direction.

[0055] When the feed adjusting body 55 is turned in the opposite direction from the neutral angle, a reciprocating oscillating motion is given to the oscillating arm 51 side according to its turning angle amount, and because the phase is reversely transmitted in this case, it is possible to widen a stitch pitch in a backward feed direction.

[0056] The horizontal feed shaft 46 is disposed further on the downstream side (on the left side in Figs. 2 and 3) in the cloth feed direction than the shuttle shaft 32. The feeding amount variable portion 52 is coupled to one end portion in the direction of axis on the vertical drum portion 22 side of the horizontal feed shaft 46, and reciprocation-turning drive force is given to the one end portion from the up-down feed shaft 43 via the feeding amount variable portion 52. The other end portion in the direction of axis of the horizontal feed shaft 46 is coupled to the horizontal feed arm 47, to transmit reciprocating drive force along the X-axis direction to the feed base 42 via the horizontal feed arm 47.

[0057] The lower end portion (base end portion) of the horizontal feed arm 47 is fixedly coupled to the one end portion in the direction of axis of the horizontal feed shaft 46, and the upper end portion (oscillation end portion) of the horizontal feed arm 47 is coupled to the feed base 42.

[0058] The feed base 42 is installed under the throat plate, and its end portion on the front side in the cloth feed direction (X-axis direction) is coupled to the up-down feed shaft 43 via the crank rod 45, and the end portion on the rear side in the cloth feed direction is coupled to the horizontal feed shaft 46 via the horizontal feed arm 47.

[0059] Further, the feed base 42 is attached so as to slightly bend (off-set) the end portion on the up-down feed shaft 43 side toward the vertical drum portion 22 side.

[0060] Cloth Feed Adjusting Mechanism

[0061] A cloth feed adjusting mechanism 70 will be de-

scribed based on Figs. 5 to 7B. In these drawings, the detailed configuration of the feeding amount variable portion 52 is omitted.

[0062] The cloth feed adjusting mechanism 70 is capable of freely switching between setup stitch pitches of two different widths by matching the feed adjusting body 55 to two target turning angles, and is further capable of switching between the forward feed direction and the backward feed direction at the setup stitch pitches of the two different widths.

[0063] The cloth feed adjusting mechanism 70 includes an input arm 71 which is fixedly mounted to the feed adjusting body 55 via the pivot 56, an adjustment shaft 72 which is supported rotatably so as to be along the X-axis direction in the bed portion 21, first and second feed adjusting arms 73, 74 which are fixedly mounted to the adjustment shaft 72, a link body 75 which couples the first feed adjusting arm 73 and the turning end portion of the input arm 71, first and second adjustment screw members 76, 77 (examples as first and second adjusting members) which configure the setting of stitch pitches by manual dialing operations, first and second cam members 78, 79 which are supported turnably around the X-axis in the bed portion 21, a pitch switching cylinder 80 (an example of a pitch switching actuator) that switches between the stitch pitches respectively set by the first and second adjustment screw members 76, 77, a direction switching cylinder 81 (an example of a feed direction switching actuator) that switches between the forward and backward sewing directions, and link bodies 82 to 84 and a switching arm 85 which transmit an output of the direction switching cylinder 81 to the adjustment shaft 72.

[0064] The adjustment shaft 72, the first and second adjusting arms 73, 74, and the switching arm 85 are fixedly coupled to one another, so as to function as a turning unit 86 which integrally performs a turning motion around the X-axis in the bed portion 21.

[0065] The input arm 71 radially extends centering around the pivot 56 along the X-axis direction. On the other hand, the first feed adjusting arm 73 as well radially extends centering around the adjustment shaft 72 along the X-axis direction, and these turning end portions of the input arm 71 and the first feed adjusting arm 73 are coupled to one another by the link body 75, thereby configuring a four-node link mechanism. That is, when turning is generated on the adjustment shaft 72 side, it is possible to interlock the feed adjusting body 55 to turn via the pivot 56.

[0066] Turning power in an anticlockwise direction in Figs. 6A and 6B centering around the pivot 56 is always given to the feed adjusting body 55 by a tension spring 58.

[0067] The first and second feed adjusting arms 73, 74 both include boss-shaped contact pins 731, 741 (examples as contact portions) which project along the X-axis direction on the side surface portions thereof. These contact pins 731, 741 are respectively configured to come into contact with cam portions 781, 791 of the first and second cam members 78, 79 which will be described later, to fix turning angles around the adjustment shaft 72 of the first or second feed adjusting arms 73, 74.

[0068] The first and second adjustment screw members 76, 77 are composed of dial portions 761, 771 whose rotation operations are manually carried out, and shaft portions 762, 772 which make forward and backward movements by the rotation operations, and the dial portions 761, 771 are provided on the outer side surfaces of the sewing machine frame 20, and the shaft portions 762, 772 are supported with screw structures by the sewing machine frame 20.

[0069] With respect to the first and second adjustment screw members 76, 77, when rotation operations of the respective dial portions 761, 771 are carried out, the shaft portions 762, 772 make forward and backward movements, and the tip end portions thereof push the first and second cam members 78, 79, to turn those, thereby separately setting and inputting stitch pitches of different widths.

[0070] In addition, these setup widths of the stitch pitches input from the first and second adjustment screw members 76, 77 are values in common in the forward feed direction and the backward feed direction, forward feeding and backward feeding are performed at the stitch pitches set by the first and second adjustment screw members 76, 77.

[0071] The first and second cam members 78, 79 are respectively installed on the front side of the shaft portions 762, 772 inside the sewing machine frame 20.

[0072] The first cam member 78 includes a turning shaft 782 (an example of a first pivot) extending along the X-axis direction at its lower end portion, and a flat contact surface 783, with which the shaft portion 762 contact in a pressed manner, is formed at a region facing the shaft portion 762.

[0073] Moreover, the first cam member 78 is disposed adjacent to the first feed adjusting arm 73 in the X-axis direction, and the cam portion 781 formed at the upper portion of the cam member 78 engages the contact pin 731 of the first feed adjusting arm 73.

[0074] The cam portion 781 is, as shown in Figs. 6A and 6B, a substantially V-shaped notch opening toward the first feed adjusting arm 73 side, and the respective members are assembled such that the feed adjusting body 55 is at the neutral angle with a stitch pitch of 0 in a state in which the contact pin 731 is in contact with the V-shaped bottom portion (innermost portion). That is, the V-shaped bottom portion in the cam portion 781 is an intermediate position 784 at which a stitch pitch is set to 0.

[0075] In the cam portion 781, sloping portions facing each other with the intermediate position 784 interposed therebetween are formed, and one of those (the upper portion in Figs. 6A and 6B) is a forward feed adjusting portion 785 capable of adjusting the stitch pitch in the forward feed direction by contacting the contact pin 731 thereto. Further, the other sloping portion (the lower portion in Figs. 6A and 6B) of the cam portion 781 is a back-

ward feed adjusting portion 786 capable of adjusting the stitch pitch in the backward feed direction by contacting the contact pin 731 thereto.

[0076] A contacting position of the contact pin 731 with respect to the cam portion 781 is determined according to a turning angle around the turning shaft 782 of the first cam member 78, and the turning angle of the first cam member 78 can be set by a rotation operation of the first adjustment screw member 76.

[0077] The feed adjusting body 55 receives torque in the anticlockwise direction in Figs. 6A and 6B centering around the pivot 56 by the tension spring 58, thereby transmitting torque in the same direction to the first feed adjusting arm 73. Accordingly, when the first cam member 78 moves backward from the position shown in Fig. 6A to the position shown in Fig. 6B, the contact pin 731 moves along the forward feed adjusting portion 785. Accordingly, when the feed direction is switched to the backward feed direction, the adjustment shaft 72 is forcibly turned by the direction switching cylinder 81, to bring the contact pin 731 into contact with the backward feed adjusting portion 786. Thereby, turning the feed adjusting body 55 up to the backward feeding side over the neutral angle, makes it possible to perform sewing in the backward feed direction.

[0078] In this cam portion 781, as described above, by turning the contact pin 731 around the adjustment shaft 72, the contact pin 731 is switched from a state in which the contact pin 731 is in contact with a predetermined position of the forward feed adjusting portion 785 to a state in which the contact pin 731 is in contact with a predetermined position of the backward feed adjusting portion 786. The shape of the cam portion 781 is designed such that the stitch pitch in the forward feed direction in the state in which the contact pin 731 is in contact with the predetermined position of the forward feed adjusting portion 785 and the stitch pitch in the backward feed direction in the state in which the contact pin 731 is in contact with the predetermined position of the backward feed adjusting portion 785 are equal in their pitch widths.

[0079] The second cam member 79 extends in a state in which its longitudinal direction is substantially along the Z-axis direction, and includes a turning shaft 792 (an example of a second pivot) along the X-axis direction at a substantially intermediate position in the longitudinal direction, and a flat contact surface 793, with which the shaft portion 772 contacts in a pressed manner, is formed slightly above the turning shaft 792 and at a region facing the shaft portion 772.

[0080] Moreover, the second cam member 79 is disposed adjacent to the second feed adjusting arm 74 in the X-axis direction, and the cam portion 791 formed at the lower portion of the cam member 79 engages the contact pin 741 of the second feed adjusting arm 74.

[0081] The cam portion 791 has, as shown in Figs. 7A and 7B, an intermediate position 794, a forward feed adjusting portion 795, and a backward feed adjusting portion 796 in the same way as the cam portion 781 of the first cam member 78. Because these have the structures which are the same as those of the cam portion 781 of the first cam member 78, descriptions thereof will be omitted.

[0082] The upper end portion of the second cam member 79 is coupled to a plunger of the pitch switching cylinder 80 via a link body 801. Normally, the pitch switching cylinder 80 is, as shown in Fig. 7A, in a state in which the plunger is brought backward, thereby leading to a state in which the contact surface 793 of the second cam member 79 is separated from the tip end portion of the shaft portion 772 of the second adjustment screw member 77, so as to maintain a state in which the cam portion 791 as well is spaced from the contact pin 741 of the second feed adjusting arm 74. That is, in this state, not the stitch pitch set by the second adjustment screw member 77, but the stitch pitch set by the first adjustment screw member 76 is selected.

[0083] In the case where the stitch pitch is switched to the stitch pitch set by the second adjustment screw member 77, as shown in Fig. 7B, the plunger of the pitch switching cylinder 80 moves forward, and the second cam member 79 turns in the clockwise direction centering around the turning shaft 792, to switch to a state in which the cam portion 791 is in contact with the contact pin 741. When the contact surface 793 of the second cam member 79 contacts the tip end portion of the shaft portion 772 of the second adjustment screw member 77, the second cam member 79 stops turning, to switch to the stitch pitch set by the second adjustment screw member 77.

[0084] At this time, the stitch pitch set by the second adjustment screw member 77 needs to be set to a value lower than the stitch pitch set by the first adjustment screw member 76. If the stitch pitch set by the second adjustment screw member 77 is set to be a higher value, even when a motion of switching to the second cam member 79 is performed by the pitch switching cylinder 80, the cam portion 791 does not reach the contact pin 741, which does not allow to switch to the stitch pitch set by the second adjustment screw member 77. That is, the second adjustment screw member 77 is for setting a small pitch.

[0085] As shown in Figs. 5 and 8A, one end portion of the link body 82 is coupled to the plunger of the direction switching cylinder 81, and the other end portion of the link body 82 is coupled to one arm portion of a bell crank member 83 supported turnably by the bed portion 21. Moreover, the other arm portion of the bell crank member 83 is coupled to one end portion of the link body 84, and the other end portion of the link body 84 is coupled to a turning step portion of the switching arm 85 fixedly mounted to the end portion of the adjustment shaft 72. With this configuration, when the plunger of the direction switching cylinder 81 performs a backward motion, turning force in a clockwise direction in Figs. 6A to 8B is given to the adjustment shaft 72 via the link members 82 and 84, the bell crank member 83, and the switching arm 85. There-

by, the respective contact pins 731, 741 move from the forward feed adjusting portions 785, 795 toward the backward feed adjusting portions 786 and 796 side in the respective cam portions 781, 791, and even in the case where sewing is performed at any stitch pitch set by the first or second adjustment screw member 76, 77, switching is carried out from forward feeding to backward feeding.

[0086] A marking 821 is marked along the way of the above-described link body 82. This is marked for detecting a motion of the slight operation amount because it is necessary for the direction switching cylinder 81 to carry out driving in a slight operation amount to an extent that the sewing direction is not switched in pitch switching control which will be described later.

[0087] That is, an optical position detecting sensor 87 (an example of detecting means) that detects the marking 821 is installed together to the link body 82, and when the plunger of the direction switching cylinder 81 moves backward by a slight operation amount set in advance, the marking 821 enters the range of detection by the position detecting sensor 87, to output a detection signal. Thereby, when a motion in the slight operation amount is detected, control for stopping the direction switching cylinder 81 so as not to cause a further motion is performed.

[0088] Control System of Sewing Machine

[0089] A control system of the sewing machine 10 will be described with reference to Fig. 9.

[0090] The sewing machine 10 includes a control unit 90 which performs motion controls in the respective configurations. A solenoid valve 802 that controls the motion of the pitch switching cylinder 80, and a solenoid valve 811 that controls the motion of the direction switching cylinder 81 are connected to the control unit 90 via respective drive circuits 803 and 812, and the aforementioned position detecting sensor 87 installed together to the direction switching cylinder 81 as well is connected to the control unit 90.

[0091] Further, a pitch selecting switch 95 that switches the stitch pitch set by the first adjustment screw member 76 to the stitch pitch set by the second adjustment screw member 77, and a direction selecting switch 96 that switches between the forward and backward sewing directions are connected to the control unit 90 via an interface 97.

[0092] Further, the sewing machine motor 16 and an encoder 17 that detects the number of rotations of the sewing machine motor 16 are connected to the control unit 90 via a motor drive circuit 161.

[0093] The control unit 90 includes a CPU 91, a ROM 92, a RAM 93, and an EEPROM 94, and controls the sewing machine motor 16 to keep a target speed while monitoring an output from the encoder 17.

[0094] The cloth feed adjusting device of the present embodiment includes the cloth feed adjusting mechanism 70 and the control system shown in Fig. 9.

[0095] Pitch switching control

[0096] Pitch switching control that the control unit 90 performs with respect to the cloth feed adjusting mechanism 70 will be described in a timing chart shown in Fig. 10.

[0097] First, on the premise of the motion, as shown in Fig. 6B, sewing is being performed at the stitch pitch set by the first adjustment screw member 76 in a state in which the contact pin 731 is in contact with the cam portion 781 of the first cam member 78. At this time, the pitch switching cylinder 80 is in a state in which the plunger moved backward, and as shown in Fig. 7A, the second cam member 79 is spaced from the second adjustment screw member 77. Moreover, the direction switching cylinder 81 is, as shown in Fig. 8A, in a state in which the plunger is moved forward, and the contact pin 731 is in contact with the forward feed adjusting portion 785 in the cam portion 781 of the first cam member 78 which is currently selected.

[0098] When the pitch selecting switch 95 is pressed (ON in Fig. 10A), the control unit 90 controls the solenoid valve 811 to move the plunger of the direction switching cylinder 81 backward (ON in Fig. 10B). Further, at the same time, the control unit 90 controls the solenoid valve 802 to move the plunger of the pitch switching cylinder 80 forward (ON in Fig. 10C).

[0099] By this motion of the direction switching cylinder 81, the adjustment shaft 72 is caused to turn in a clockwise direction in Figs. 7A and 7B, the contact pin 741 moves in the direction so as to separate away from the forward feed adjusting portion 795 of the cam portion 791. Simultaneously, as shown in Fig. 7B, the pitch switching cylinder 80 pushes the upper end portion of the second cam member 79, to move the cam portion 791 toward the contact pin 741 side. At this time, because the contact pin 731 moves in the direction so as to separate away from the forward feed adjusting portion 785, and the contact pin 741 moves in the direction so as to separate away from the forward feed adjusting portion 795, sliding motions between these contact pins and the cam portions are avoided or reduced. Accordingly, the pitch switching cylinder 80 is capable of smoothly performing the switching motion with a small output.

[0100] On the other hand, when the plunger of the direction switching cylinder 81 moves backward to an extent, the marking 821 is detected by the position detecting sensor 87 (Fig. 8B and ON in Fig. 10D), and the control unit 90 stops the actuation of the direction switching cylinder 81 simultaneously with this detection by the sensor (OFF in Fig. 10B), and the plunger is returned into the forward-movement state.

[0101] Thereby, the contact pin 741 is returned before the contact pin 741 reaches the backward feed adjusting portion 796 of the cam portion 791, and the contact pin 741 contacts the forward feed adjusting portion 795, to set to the stitch pitch set by the second adjustment screw member 77.

[0102] In addition, when the pitch selecting switch 95 is pressed again (OFF in Fig. 10A), the plunger of the

pitch switching cylinder 80 moves backward (OFF in Fig. 10C), and the cam portion 791 of the second cam member 79 is separated from the contact pin 741, and the cam portion 781 of the first cam member 78 again contacts the contact pin 731, to return to the stitch pitch set by the first adjustment screw member 76.

[0103] In the sewing machine 10, in the pitch switching control, at the time of switching to the stitch pitch set by the second adjustment screw member 77 from the state in which the stitch pitch set by the first adjustment screw member 76 is selected, the direction switching cylinder 81 is, simultaneously with the pitch switching cylinder 80, driven within the range in which the sewing direction is not switched.

[0104] In this manner, because the respective contact pins 731, 741 produce movement from the forward feed adjusting portions 785, 795 toward the backward feed adjusting portions 786 and 796 side, and the pitch switching cylinder 80 performs the switching motion to the second cam member 79 at that time, and therefore, sliding contact between the contact pin 731 and the cam portion 781 of the first cam member 85, and sliding contact between the contact pin 741 and the cam portion 791 of the second cam member 79 are avoided or reduced. Accordingly, sliding friction is reduced, and the load on the pitch switching cylinder 80 is reduced, which makes it possible to use a downsized cylinder with a small output.

[0105] Further, it becomes possible to more rapidly perform a switching motion by a reduction in sliding friction.

[0106] Moreover, due to a reduction in sliding friction, it becomes possible to reduce wear of the members, which makes it possible to achieve an improvement in durability and maintenance efficiency.

[0107] Further, in the sewing machine 10, the actuation of the direction switching cylinder 81 in the pitch switching control is preferably performed within the range in which the contact pin 741 does not reach the backward feed adjusting portion 796. In order to satisfy this condition, the position detecting sensor 87 that detects that the direction switching cylinder 81 performs a motion to a certain range is provided, to perform the control for stopping the direction switching cylinder 81 upon detection by the position detecting sensor 87.

[0108] In this manner, it becomes possible to cause the direction switching cylinder 81 to perform a motion in an appropriate operation amount, which makes it possible avoid the situation in which the contact pin 741 contacts the backward feed adjusting portion 796, to cause sliding friction, or the like, a more secure motion is performed, that makes it possible to achieve an improvement in reliability of the mechanism.

[0109] In the sewing machine 10, in order to perform a slight motion of the direction switching cylinder 81 in the pitch switching control, when an actual operation amount reaches a target value by the position detecting sensor 87, the control for stopping the direction switching cylinder 81 is performed. However, the condition for stopping the direction switching cylinder 81 is not limited to an operation amount, and may be set according to an operation time, for example.

[0110] For example, in the case where a required operation time until the contact pin 741 reaches the backward feed adjusting portion 796 from the forward feed adjusting portion 795 by the direction switching cylinder 81 is known in advance, a time shorter than the required operation time may be determined as an actuation time of the direction switching cylinder 81, to perform the control for stopping the direction switching cylinder 81 at a point in time of passage of the actuation time.

[0111] For example, in the case where the above-described required operation time is 10 [ms], when a time shorter than the required operation time of 10 [ms], for example, 5 [ms] is measured from the start of driving of the direction switching cylinder 81 by a built-in clock (an example of clocking means) of the CPU 91 of the control unit 90, the control for stopping the actuation of the direction switching cylinder 81 is performed.

[0112] Thereby, in the pitch switching control, it is possible to actuate the direction switching cylinder 81 in a slight operation amount, which makes it possible to obtain the effect which is the same as in the case where the position detecting sensor 87 is used.

[0113] Second Embodiment

[0114] As a second embodiment, another example of a cloth feed adjusting mechanism will be described based on Figs. 11 and 13. In these drawings, illustration of the feed adjusting body 55 is omitted, and only the pivot 56 thereof is illustrated. Further, the feed adjusting body 55 and the feeding device 40 have the mechanisms which are the same as those in the first embodiment.

[0115] The aforementioned cloth feed adjusting mechanism 70 includes the two feed adjusting arms 73, 74, and the two cam members 78, 79. However, this cloth feed adjusting mechanism 70A is different from the cloth feed adjusting mechanism 70 in the point that a single feed adjusting arm and a single cam member are used.

[0116] The cloth feed adjusting mechanism 70A includes an input arm 71A which is fixedly mounted to the feed adjusting body 55 via the pivot 56, an adjustment shaft 72A which is supported rotatably so as to be along the X-axis direction in the bed portion 21, a feed adjusting arm 73A which is fixedly mounted to the adjustment shaft 72A, a link body 75A which couples the feed adjusting arm 73A and the turning end portion of the input arm 71A, first and second adjustment screw members 76A, 77A (examples as first and second adjusting members) which configure the setting of stitch pitches by manual dialing operations, a cam member 78A which is supported turnably around the X-axis in the bed portion 21, a pitch switching cylinder 80A (an example of a pitch switching actuator) that switches between stitch pitches respectively set by the first and second adjustment screw members 76A, 77A, a direction switching cylinder 81A (an example of a feed direction switching actuator) that switches between the forward and backward sewing di-

rections, and a switching arm 85A which transmits an output of the direction switching cylinder 81A to the adjustment shaft 72A.

[0117] The adjustment shaft 72A, the feed adjusting arms 73A, and the switching arm 85A are fixedly coupled to one another, and function as a turning unit 86A which integrally perform a turning motion around the X-axis in the bed portion 21.

[0118] The input arm 71A radially extends centering around the pivot 56 along the X-axis direction. The input arm 71A is capable of being interlocked with the feed adjusting arm 73A capable of turning around the X-axis by the link body 75A.

[0119] The feed adjusting arm 73 includes a boss-shaped contact pin 731A (an example of a contact portion) which projects along the X-axis direction on the side surface portion thereof, and is configured to contact a cam portion 781A of the cam member 78A, to fix a turning angle around the adjustment shaft 72A of the feed adjusting arm 73A.

[0120] The first and second adjustment screw members 76A, 77A have substantially the same structures as the aforementioned adjustment screw members 76, 77. Accordingly, the first and second adjustment screw members 76A, 77A include shaft portions 762A, 772A which make forward and backward movements by rotation operations of dial portions 761A, 771A.

[0121] In the case of the first and second adjustment screw members 76A, 77A as well, normally, sewing is performed at the stitch pitch set by the first adjustment screw member 76A, it is possible to switch the stitch pitch to the stitch pitch set by the second adjustment screw member 77A by an actuation of the pitch switching cylinder 80A.

[0122] Further, in the point that sewing is performed at the same setup stitch pitch in the cases of forward feeding and backward feeding, and it is necessary to make the stitch pitch set by the second adjustment screw member 77A smaller than the stitch pitch set by the first adjustment screw member 76A, the first and second adjustment screw members 76A, 77A are the same as those of the respective adjustment screw members 76, 77.

[0123] However, the first and second adjustment screw members 76A, 77A are disposed one above the other such that the first adjustment screw member 76A is on the upper side, on the side surface of the sewing machine frame.

[0124] The cam member 78A is installed on the front side of the shaft portions 762A, 772A arranged one above the other inside the sewing machine frame 20.

[0125] In the cam member 78A, first and second contact surfaces 787A, 788A with which the shaft portions 762A, 772A respectively come into contact are provided one above the other, and a turning shaft 782A (an example of a pivot) along the X-axis direction is included between the contact surfaces 787A, 788A. Further, a torsion coil spring 789A which pushes the first contact surface 787A of the cam member 78A in a direction in which first contact surface 787A firmly presses the first adjustment screw member 76A is attached to the turning shaft 782A.

[0126] Moreover, the cam member 78A is disposed adjacent to the feed adjusting arm 73A in the X-axis direction, and the cam portion 781A formed in the vicinity of the end portion on the opposite side of the respective contact surfaces 787A, 788A of the cam member 78A engages the contact pin 731A of the feed adjusting arm 73A.

[0127] As shown in Fig. 13, the cam portion 781A of the cam member 78A is formed so as to be perforated into a substantially triangle with respect to the cam member 78A forming a plate shape. In this cam portion 781A, a region corresponding to one side of the triangle is a forward feed adjusting portion 785A, a region corresponding to one side which faces adjacent to the forward feed adjusting portion 785A is a backward feed adjusting portion 786A, and a region corresponding to the vertex between the adjusting portions 785A, 786A is an intermediate position 784A.

[0128] This cloth feed adjusting mechanism 70A has the feature that, as mentioned above, the cam member 78A and the feed adjusting arm 73A are each composed of one member, to achieve switching of setup stitch pitches by the two adjustment screw members 76A, 77A.

[0129] The principle of actuation will be described. First, when a desired stitch pitch is set and adjusted by the first adjustment screw member 76A, and a desired stitch pitch is set and adjusted by the second adjustment screw member 77A so as to be smaller than that of the first adjustment screw member 76A, the cam member 78A firmly presses the first adjustment screw member 76A with its contact surface 787A by the torsion coil spring 789A, to form a gap between the contact surface 788A and the second adjustment screw member 77A.

[0130] The contact pin 731A shown by the solid line in Fig. 13 indicates a contacting position with respect to the forward feed adjusting portion 785A at that time.

[0131] At the time of switching the pitch, the pitch switching cylinder 80A is actuated, and the plunger pushes the top surface in the vicinity of the rear end portion of the cam member 78A downward. Thereby, turning the cam member 78A in the anticlockwise direction in the drawing centering around the turning shaft 782A, to switch to a state in which the contact surface 788A firmly presses the second adjustment screw member 77A. When the cam member 78A turns in the anticlockwise direction, the contact pin 731A moves toward the intermediate position 784A while sliding over the forward feed adjusting portion 785A (the contact pin 731A by the alternate long and two short dashed line), and therefore, the feed adjusting arm 73A (not shown in Fig. 13) engaging the contact pin 731A turns in the clockwise direction in Fig. 13. Thereby, turning the feed adjusting body 55 along with the feed adjusting arm 73A, to switch to the stitch pitch set by the second adjustment screw member 77A.

[0132] Further, the direction switching cylinder 81A gives turning in the arrow direction (the clockwise direction) in Fig. 12 to the switching arm 85A at the time of switching from forward feeding to backward feeding. Thereby, turning the feed adjusting arm 73A along with the switching arm 85A in a clockwise direction, to move the contact pin 731A to a position of 731R in Fig. 13. Thereby, bringing the contact pin 731A into contact with the backward feed adjusting portion 786A, to be able to turn the feed adjusting body 55 so as to perform backward feeding at the setup stitch pitch.

[0133] The pitch switching control in the cloth feed adjusting mechanism 70A with such a configuration will be described. In the case of the cloth feed adjusting mechanism 70A as well, a marking is attached to a forward and backward motion region in the same way as the direction switching cylinder 81 mentioned above, and a slight motion to an extent that forward feeding is not switched to backward feeding is detected by a position detecting sensor.

[0134] Then, with respect to the pitch switching cylinder 80A and the direction switching cylinder, the motion control which is the same as that shown by the timing chart of Fig. 10 with respect to the pitch switching cylinder 80 and the direction switching cylinder 81 mentioned above is performed.

[0135] That is, at the time of switching the pitch, the pitch switching cylinder 80A and the direction switching cylinder simultaneously start actuations. Thus, the contact pin 731A is spaced from the forward feed adjusting portion 785A of the cam portion 781A by the direction switching cylinder, and simultaneously, the cam member 78A is turned by the pitch switching cylinder 80A. Therefore, the contact pin 731A moves to the setting position by the second adjustment screw member 77A without sliding over the forward feed adjusting portion 785A.

[0136] Further, with respect to the direction switching cylinder, because the plunger is returned to the original position when a slight motion is detected by the position detecting sensor, it is possible to move the contact pin 731A to a planned position.

[0137] That is, with respect to this cloth feed adjusting mechanism 70A as well, in the same way in the case of the cloth feed adjusting mechanism 70, it is possible to achieve downsizing, and achieve an improvement in motion rapidity and a reduction in sliding friction of the respective members with respect to the pitch switching cylinder 80A.

[0138] Third Embodiment

[0139] As a third embodiment, another example of the transmission mechanism 48 which converts rotary drive force of the up-down feed shaft 43 into reciprocation-turning drive force, to transmit the force to the horizontal feed shaft 46 will be described. That is, the aforementioned cloth feed adjusting mechanisms 70 and 70A are both applicable not only to the transmission mechanism 48, but also to a transmission mechanism 48B shown hereinafter. In the description of the transmission mechanism 48B, the same reference numerals are given for the same configuration of the sewing machine 10 mentioned above, and overlapping descriptions will be omitted.

[0140] The transmission mechanism 48B includes an eccentric cam 49B fixedly mounted to the up-down feed shaft 43, a crank rod 50B whose one end portion is coupled to the up-down feed shaft 43 via the eccentric cam 49B, an oscillating arm 51B which is fixedly mounted to the horizontal shaft 46, to oscillate centering around the horizontal shaft 46, and a feeding amount variable portion 52B which couples the other end portion of the crank rod 50B and the oscillation end portion of the oscillating arm 51B, and is capable of adjusting a width of a reciprocation-turning angle transmitted to the horizontal feed shaft 46.

[0141] The feeding amount variable portion 52B includes a link body 53B whose one end portion in the longitudinal direction is coupled to the oscillation end portion of the oscillating arm 51B, and whose intermediate portion is coupled to the other end portion of the crank rod 50B, a pair of square pieces 54B which are held by the other end portion of the link body 53B, a feed adjusting body 55B having a guide groove 551B that guides the square pieces 54B, and a pivot 56B which allows the feed adjusting body 55B to be turnable around the Y-axis.

[0142] The link body 53B is coupled turnably around the Y-axis to the oscillating arm 51B, the square pieces 54B, and the crank rod 50B respectively with the both end portions and the intermediate portion.

[0143] Because the other end portion of the crank rod 50B is coupled to the intermediate portion of the link body 53B, when the up-down feed shaft 43 rotates, a reciprocating motion containing a vertical direction component is given to the link body 53B. The square pieces 54B are attached to the other end portion of the link body 53B, and the square pieces 54B are structured so as to regulate its moving direction by the guide groove 551B formed in the feed adjusting body 55B.

[0144] In this case, for example, as shown in Fig. 15, when the guide groove 551B is directed in the vertical direction, the reciprocating motion input from the crank rod 50B to the link body 53B is substantially in the vertical direction, and the link body 53B performs a reciprocation-turning motion with a coupling portion with the oscillating arm 51B serving as a fulcrum. Therefore, the turning end portion side of the oscillating arm 51B is a substantially resting state, and no turning motion is transmitted to the horizontal feed shaft 46. That is, this direction is a neutral angle in the feed adjusting body 55B.

[0145] When the feed adjusting body 55B is turned in any direction from the neutral angle, the guide groove 551B is inclined in an oblique direction, and therefore, a reciprocating motion component in a right and left direction (in the X-axis direction) is generated in the link body 53B, and this is transmitted to the turning end portion of the oscillating arm 51B as well, thereby transmitting the turning motion to the horizontal feed shaft 46 as well. A

stroke of the reciprocation-turning transmitted to the horizontal feed shaft 46 varies according to an angular variation amount of the feed adjusting body 55B from the neutral angle.

[0146] Further, depending on whether the feed adjusting body 55B is turned in the clockwise direction or the anticlockwise direction from the neutral angle, the phase of the reciprocating motion transmitted to the horizontal feed shaft 46 is inverted. Accordingly, it is possible to optionally adjust stitch pitches in the forward direction and the backward direction according to turning angles in the respective directions.

[0147] The aforementioned cloth feed adjusting mechanisms 70, 70A are able to function in all the same ways as the transmission mechanism 48 by mounting the input arms 71, 71A to the pivot 56B in the transmission mechanism 48B.

[0148] While the first and second adjustment screw members have been described as examples of the first and second adjusting members in the embodiment described above, one or both of the first and second adjusting members may not necessarily have a screw structure in so far as they move forward or backward when operated. Further, while the pitch switching cylinder and the direction switching cylinder have been described as examples of the pitch switching actuator and the feed direction switching actuator in the embodiment described above, one or both of the pitch switching actuator and the feed direction switching actuator may be actuators other than the cylinders.

Claims

1. A cloth feed adjusting device of a sewing machine comprising:

at least one cam member (78, 79, 78A) supported by a machine frame (20) in a rotatable manner by a pivot (782, 792, 782A);
a first adjusting member (76, 76A) configured to move forward or backward when operated, and to push the at least one cam member (78, 79, 78A) to regulate a rotational position of the at least one cam member (78, 79, 78A);
a second adjusting member (77, 77A) configured to move forward or backward when operated;
a pitch switching actuator (80, 80A) coupled to the at least one cam member (78, 79, 78A), and configured to cause the at least one cam member (78, 79, 78A) to contact or separate from the second adjusting member (77, 77A); and
a control unit (90) configured to drive the pitch switching actuator (80, 80A),
wherein the at least one cam member (78, 79, 78A) comprises a cam portion (781, 791, 781A) which is formed such that a forward feed adjusting portion (785, 795, 785A) capable of adjusting a stitch pitch in a forward feeding and a backward feed adjusting portion (786, 796, 786A) capable of adjusting a stitch pitch in a backward feeding face each other and have a border at an intermediate position (784, 794, 784A) at which a stitch pitch becomes 0,
characterized in that the cloth feed adjusting device further comprises:

a turning unit (86, 86A) comprising a contact portion (731, 741, 731A) capable of contacting the cam portion (781, 791, 781A), and supported so as to be rotatable about one axis (72, 72A) with respect to the machine frame (20) to change, in accordance with a rotation angle thereof, the stitch pitch in a range from the forward feeding to the backward feeding; and
a feed direction switching actuator (81, 81A) configured to rotate the turning unit (86, 86A) such that the contact portion (731, 741, 731A) moves between the forward feed adjusting portion (785, 795, 785A) and the backward feed adjusting portion (786, 796, 786A) of the cam portion (781, 791, 781A), thereby switching a stitch direction from one of a forward feed direction and a backward feed direction to the other,
wherein, at the time of starting the operation of the pitch switching actuator (80,80A), the control unit (90) drives the feed direction switching actuator (81, 81A) in a range in which the stitch direction is not switched.

2. The cloth feed adjusting device of the sewing machine according to claim 1, wherein the at least one cam member (78, 79, 78A) comprises:

a first cam member (78) supported by the machine frame (20) in a rotatable manner by a first pivot (782) with respect to, and
a second cam member (79) supported by the machine frame (20) in a rotatable manner by a second pivot (792) and capable of contacting and separating from the second adjusting member, wherein a rotational position thereof is regulated by being pushed when contacting the second adjusting member,
the first adjusting member (76) pushes the first cam member (78) to regulate the rotational position of the first cam member (78),
when the second adjusting member (77) contacts the second cam member (79), the second adjusting member (77) pushes the second cam member (79) to regulate the rotational position of the second cam member (79),
the pitch switching actuator is coupled to the

second cam member (79), and causes the second cam member (79) to contact or separate from the second adjusting member (77),
the first cam member (78) comprises a first cam portion (781) which is formed such that a forward feed adjusting portion (785) capable of setting a stitch pitch in the forward feed direction and a backward feed adjusting portion (786) capable of setting a stitch pitch in the backward feed direction face each other and have an intermediate position (784) as a border at which the stitch pitch becomes 0,
the second cam member (79) comprises a second cam portion (791) which is formed such that a forward feed adjusting portion (795) capable of setting the stitch pitch in the forward feed direction and a backward feed adjusting portion (796) capable of setting the stitch pitch in the backward feed direction face each other and have a border at an intermediate position (794) at which a stitch pitch becomes 0,
the contact portion (731, 741) is capable of contacting one of the first cam portion (781) and the second cam portion (791), and
the feed direction switching actuator (81) rotates the turning unit (86) such that the contact portion (731, 741) moves between the forward feed adjusting portion (785, 795) and the backward feed adjusting portion (786, 796) of one of the first and second cam portions (781, 791), thereby switching the stitch direction from one of the forward feed direction and the backward feed direction to the other.

3. The cloth feed adjusting device of the sewing machine according to claim 1 or 2, further comprising detecting means (87) for detecting a predetermined operation amount of the feed direction switching actuator (81,81A),
wherein the control unit (90) performs the operation of the feed direction switching actuator (81, 81A) at the time of starting the operation of the pitch switching actuator (80, 80A) until the detecting means (87) detects the predetermined operation amount.

4. The cloth feed adjusting device of the sewing machine according to claim 1 or 2, further comprising clocking means (91) for measuring an operation time of the feed direction switching actuator (81, 81A),
wherein the control unit (90) performs the operation of the feed direction switching actuator (81, 81A) at the time of starting the operation of the pitch switching actuator (80), 80A) until the clocking means (91) measures a predetermined operation time.

FIG. 1

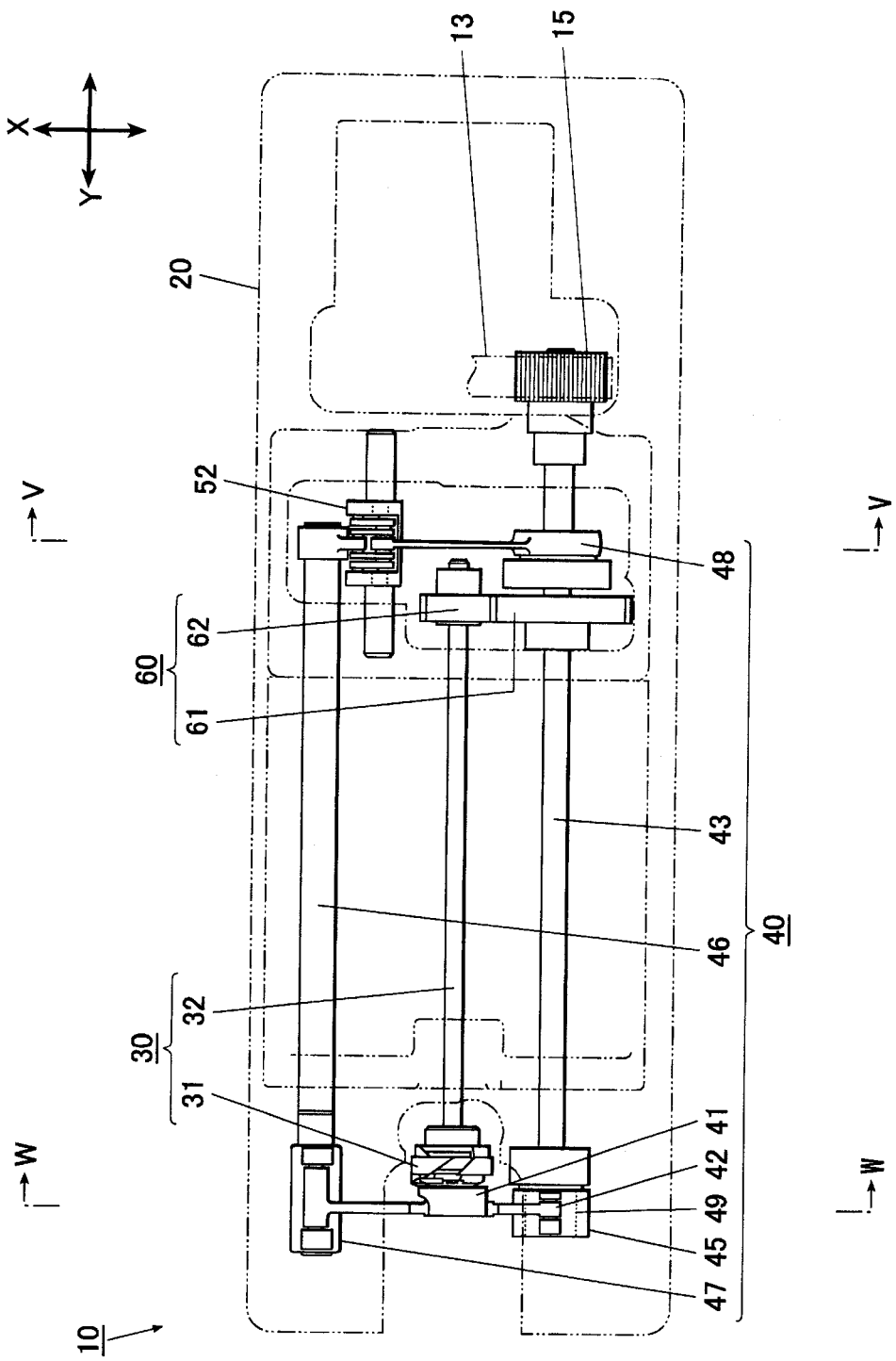


FIG. 2

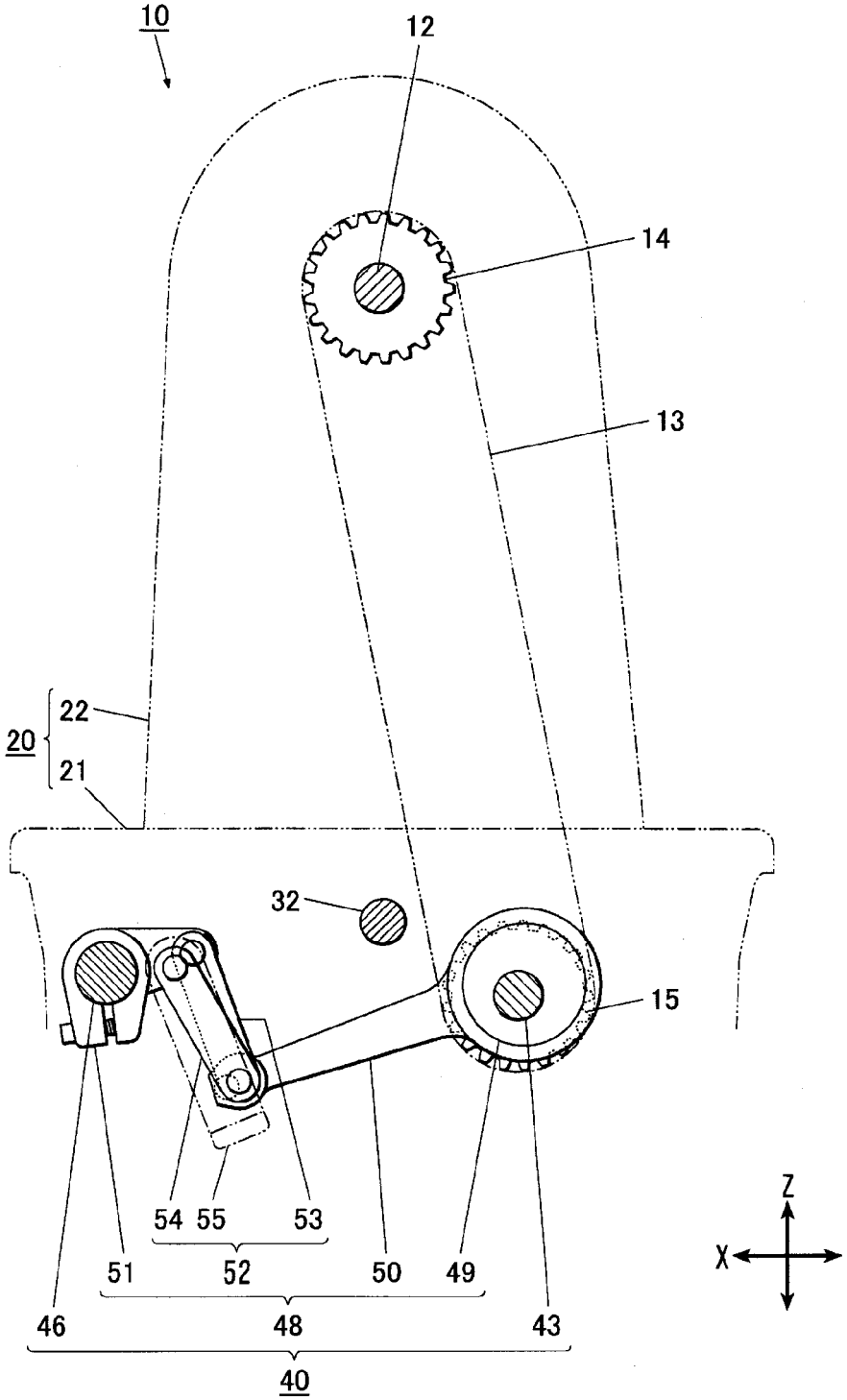


FIG. 3

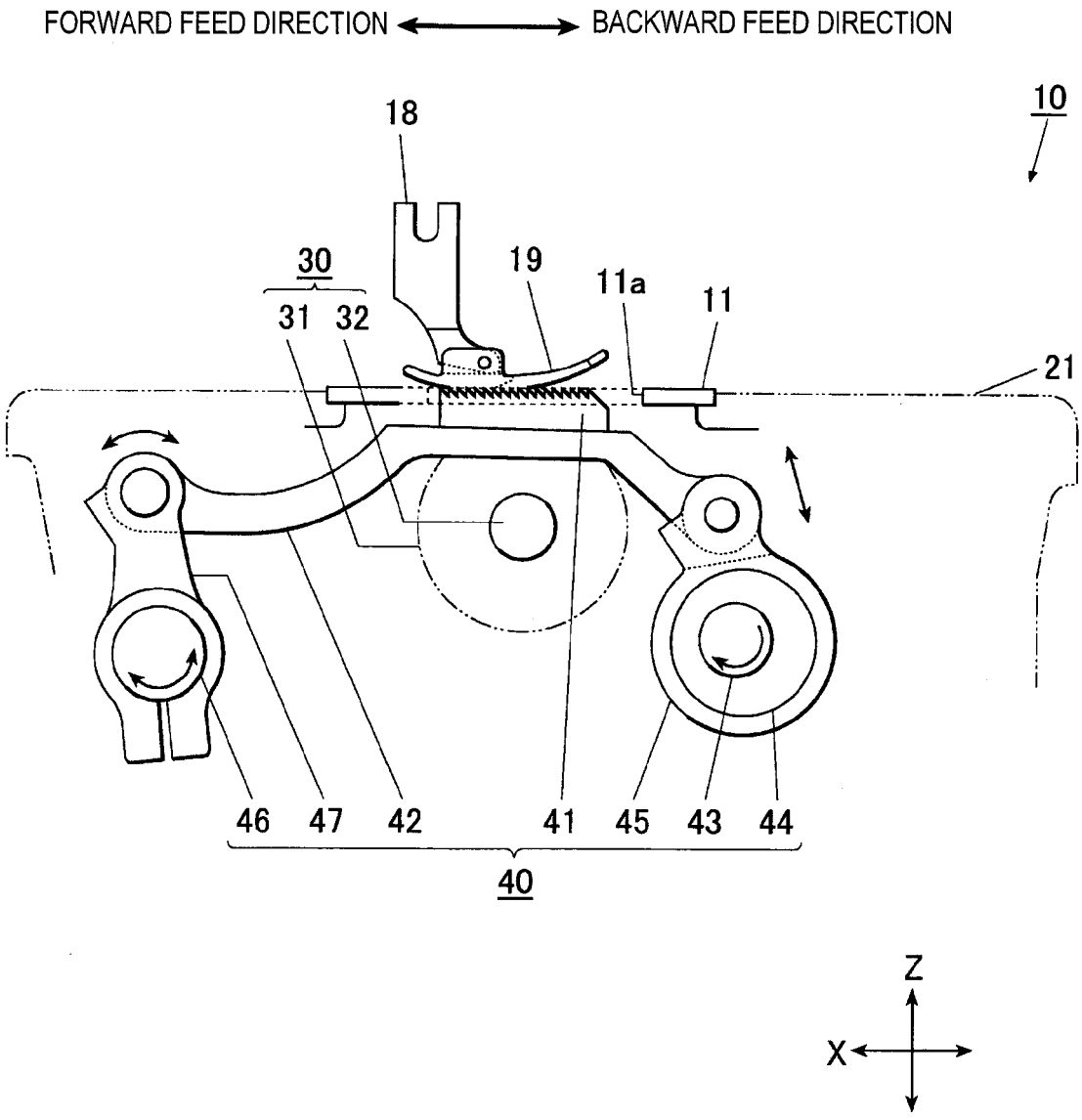

FORWARD FEED DIRECTION
BACKWARD FEED DIRECTION
10
18
30
31
32
19
11a
11
21
46
47
42
41
45
43
44
40
Z
X

FIG. 4

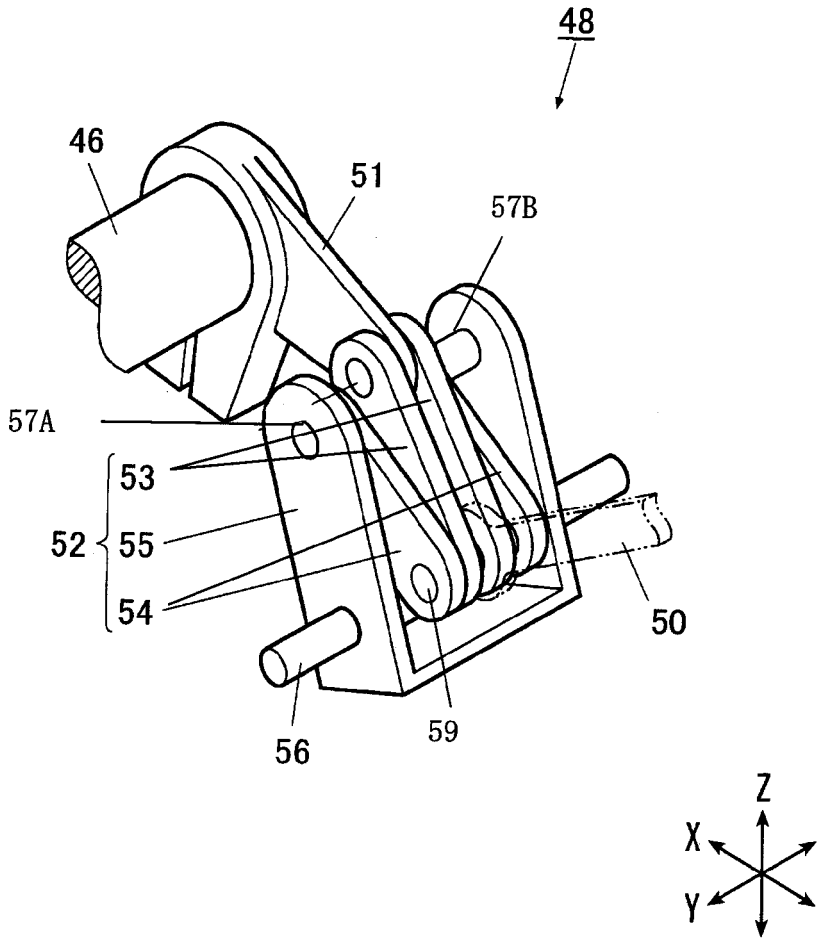


FIG. 5

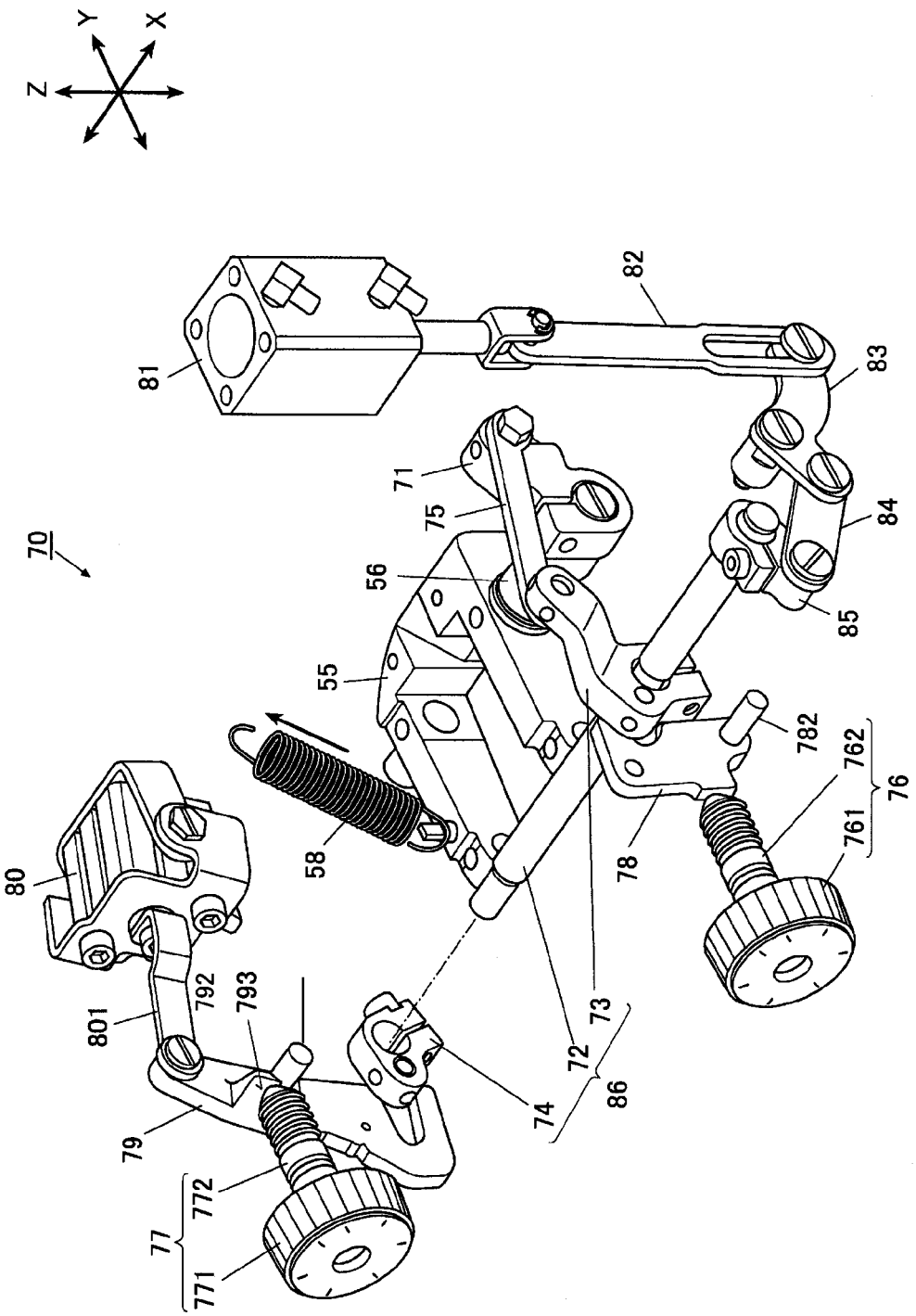

Y
X
Z
70
81
82
83
84
85
71
75
56
55
58
80
801
792
793
79
772
77
771
74
72
73
86
78
782
762
761
76

FIG. 6A

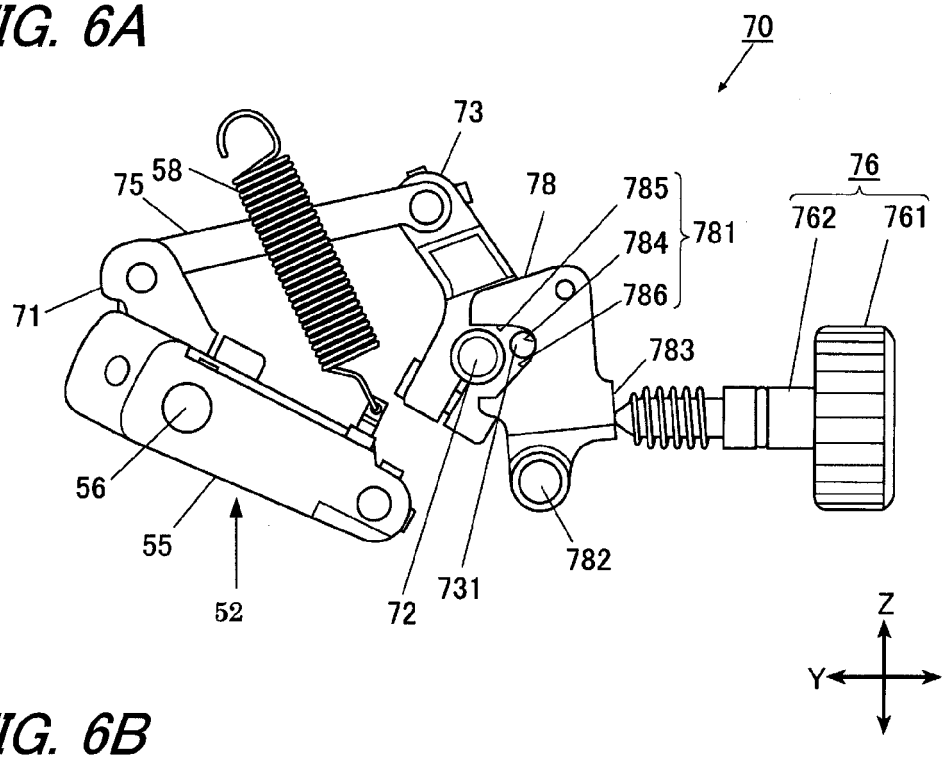

70
73
75
58
78
785
784
786
781
76
762
761
71
783
56
55
52
72
731
782
Z
Y

FIG. 6B

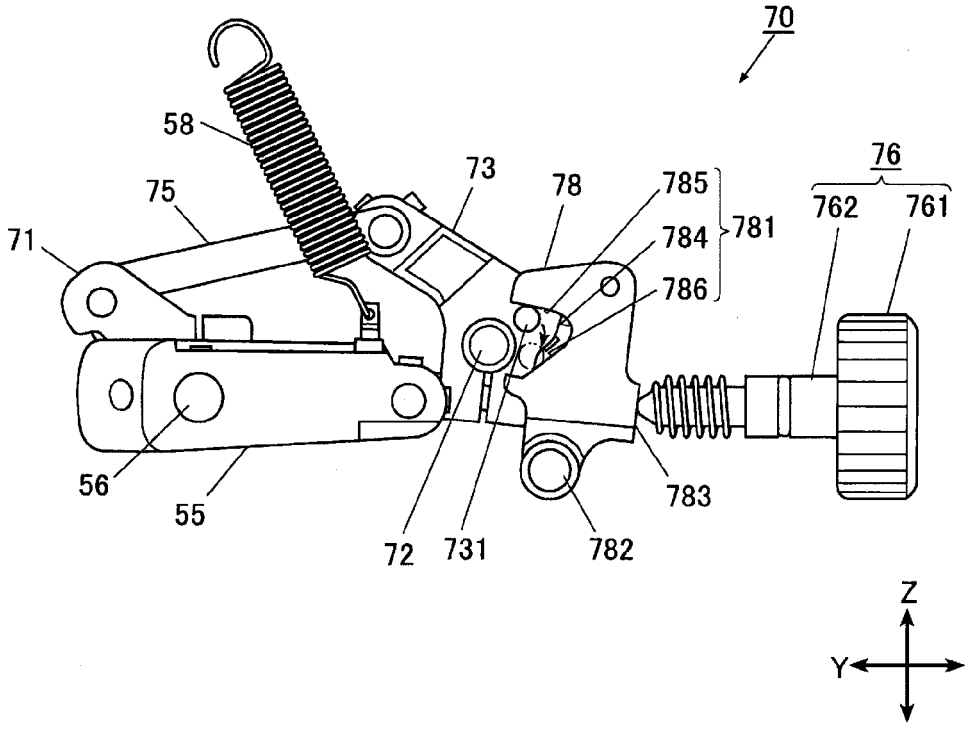

70
58
73
78
785
784
786
781
76
762
761
75
71
783
56
55
72
731
782
Z
Y

FIG. 7A

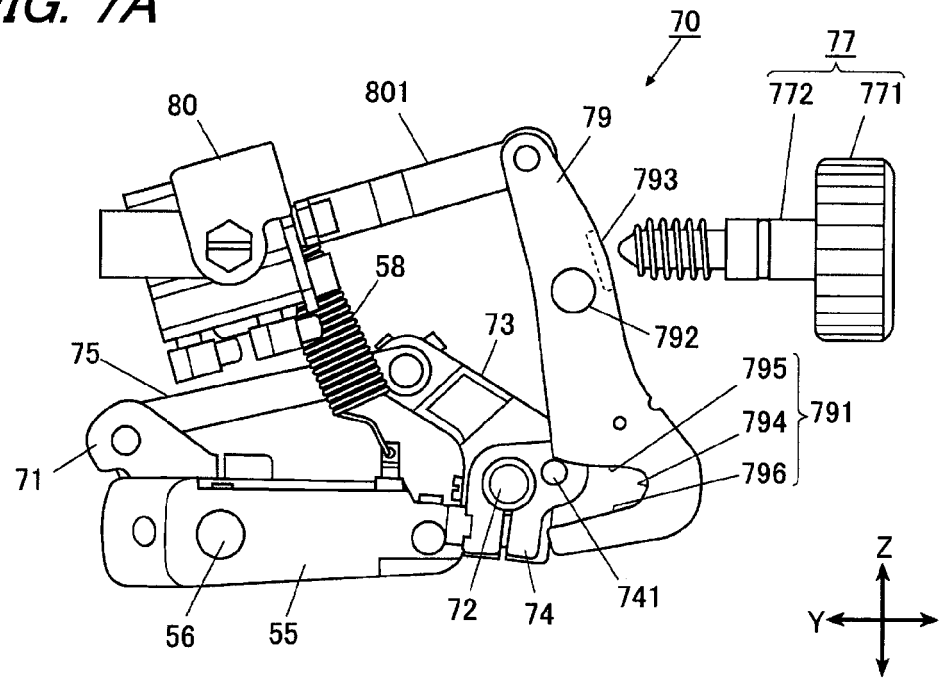

70
77
772
771
80
801
79
793
58
792
73
75
795
794
791
796
71
741
72
74
56
55
Z
Y

FIG. 7B

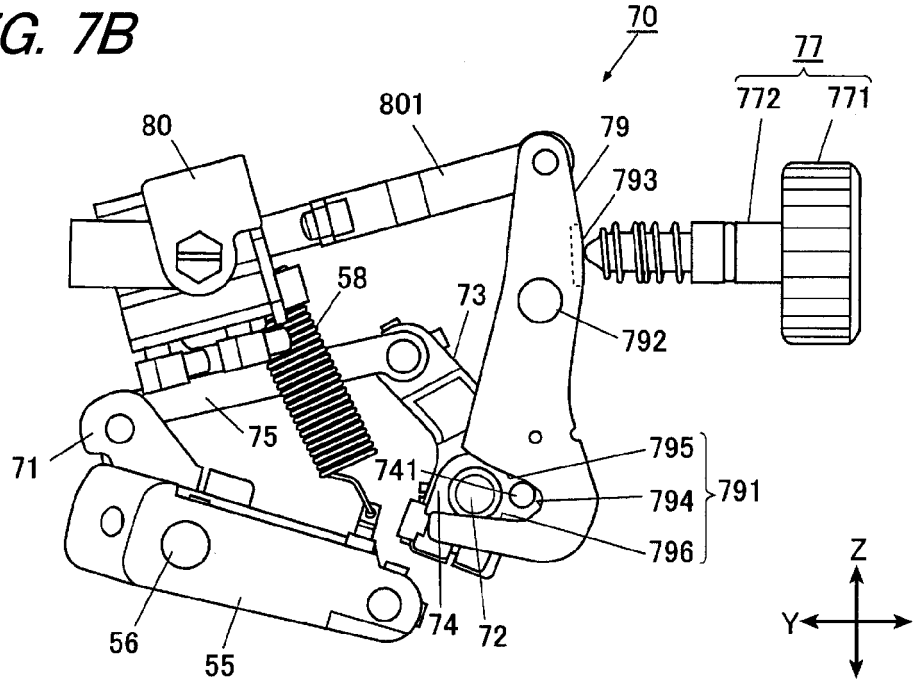

70
77
772
771
80
801
79
793
58
73
792
75
795
741
794
791
796
71
74
72
56
55
Z
Y

FIG. 8B

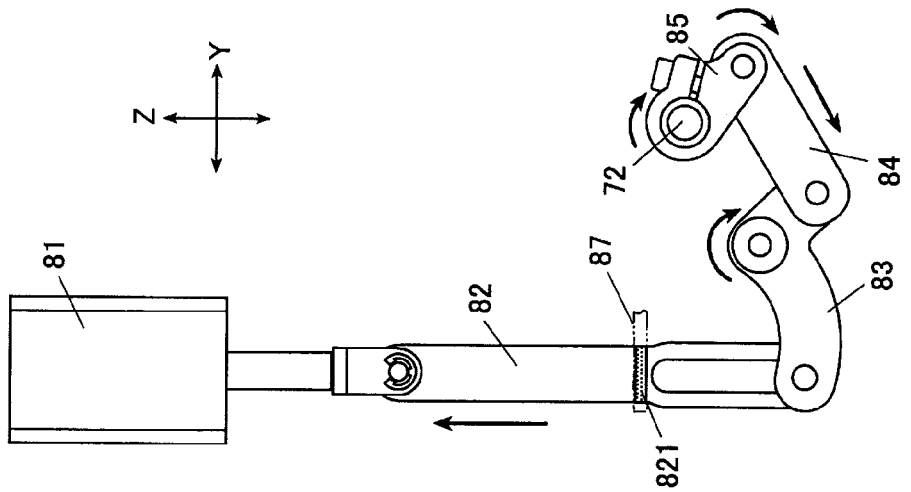


FIG. 8A

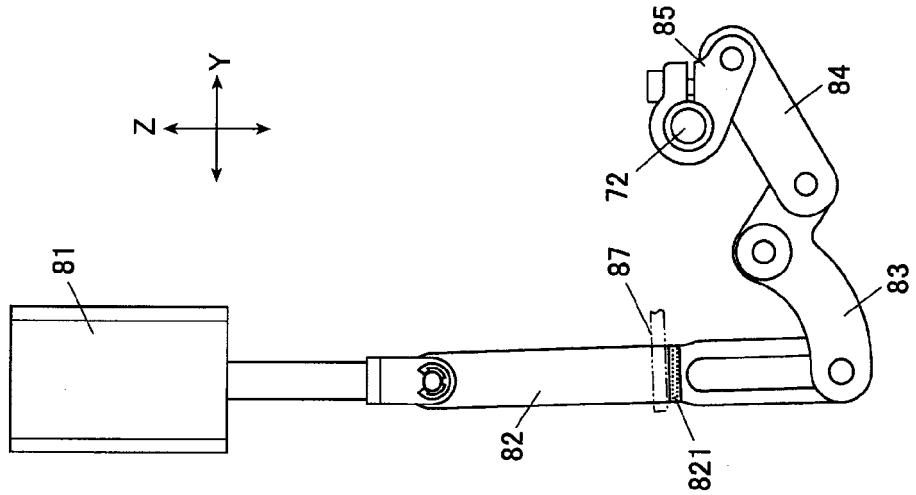


FIG. 9

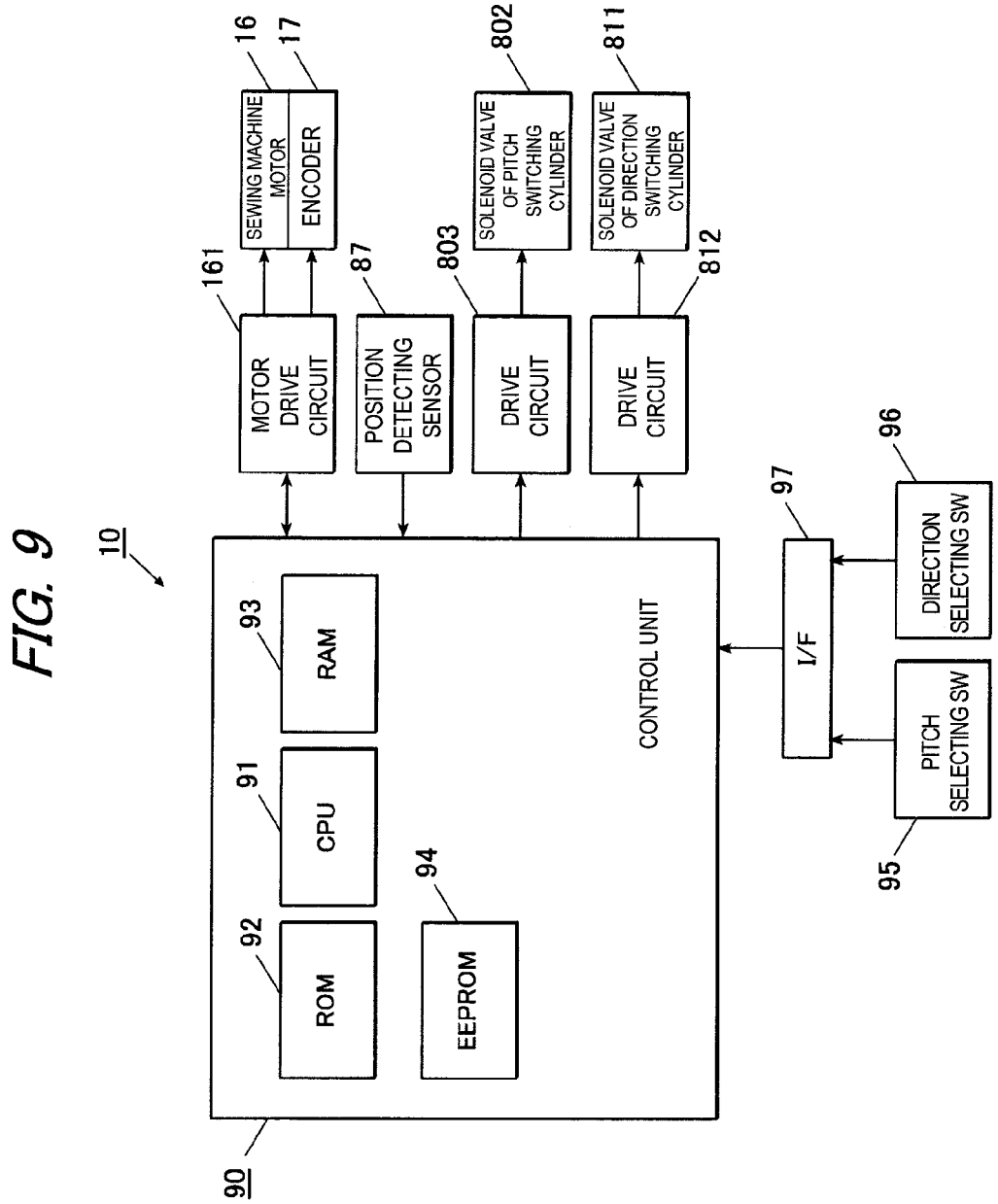

10
16
17
SEWING MACHINE MOTOR
ENCODER
802
SOLENOID VALVE OF PITCH SWITCHING CYLINDER
811
SOLENOID VALVE OF DIRECTION SWITCHING CYLINDER
161
MOTOR DRIVE CIRCUIT
87
POSITION DETECTING SENSOR
803
DRIVE CIRCUIT
812
DRIVE CIRCUIT
96
97
DIRECTION SELECTING SW
I/F
PITCH SELECTING SW
95
93
RAM
91
CPU
92
ROM
94
EEPROM
CONTROL UNIT
90

FIG. 10

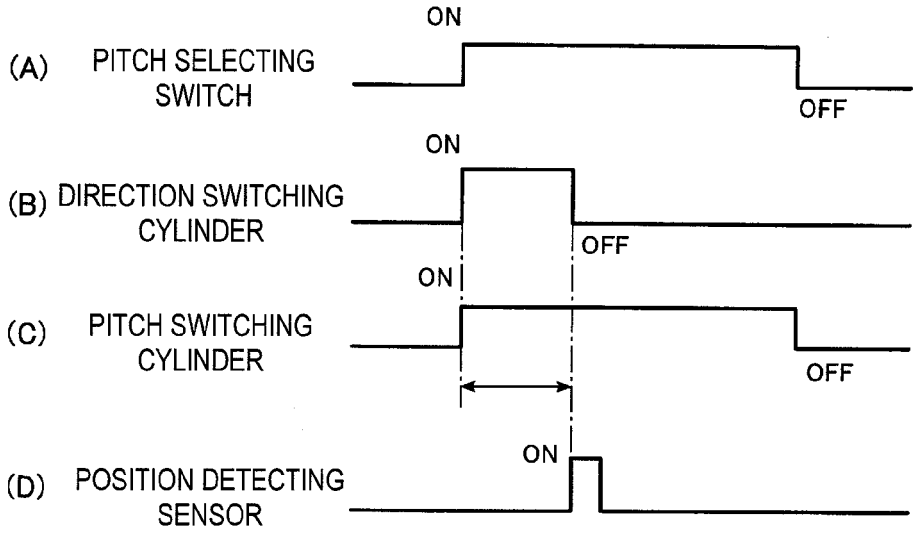

(A)
PITCH SELECTING SWITCH
ON
OFF
(B)
DIRECTION SWITCHING CYLINDER
ON
OFF
(C)
PITCH SWITCHING CYLINDER
ON
OFF
(D)
POSITION DETECTING SENSOR
ON

FIG. 11

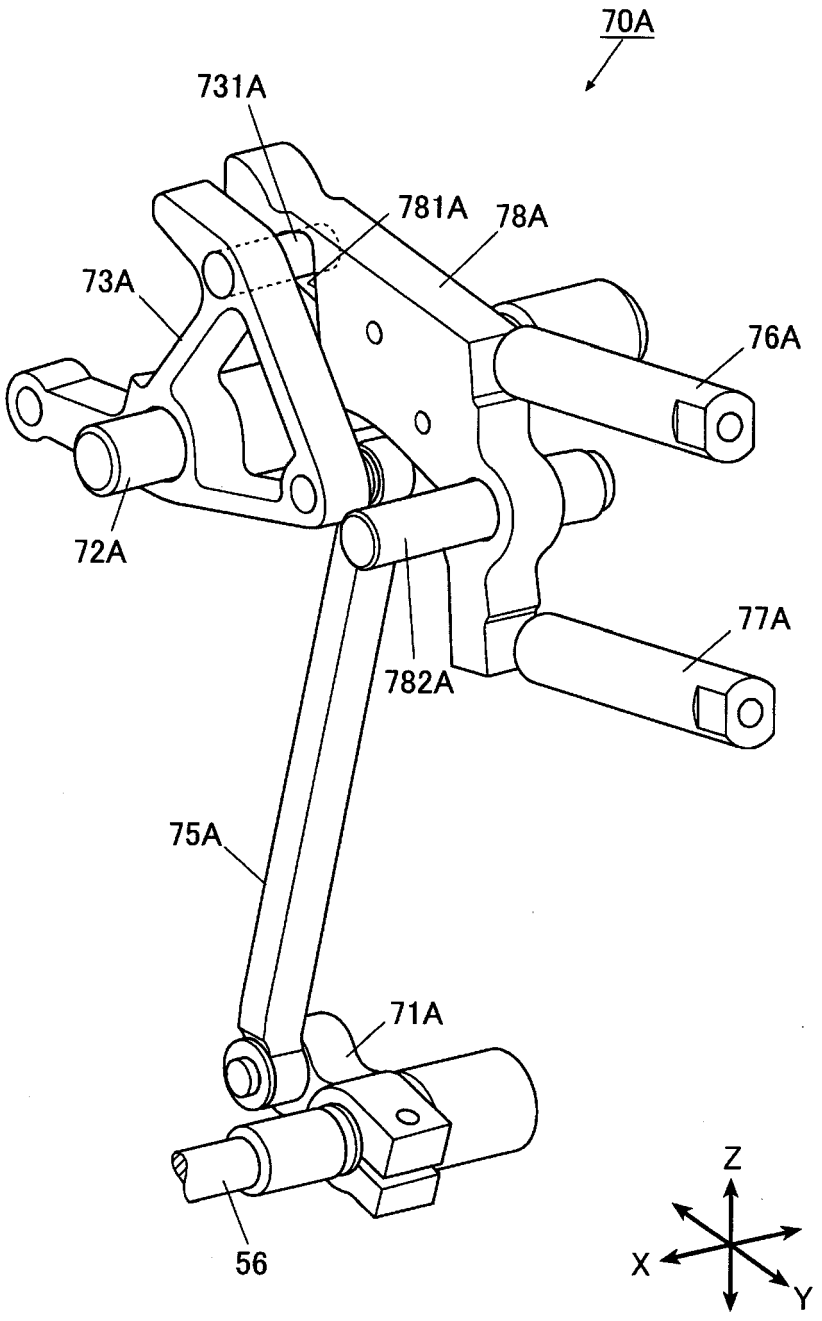


FIG. 12

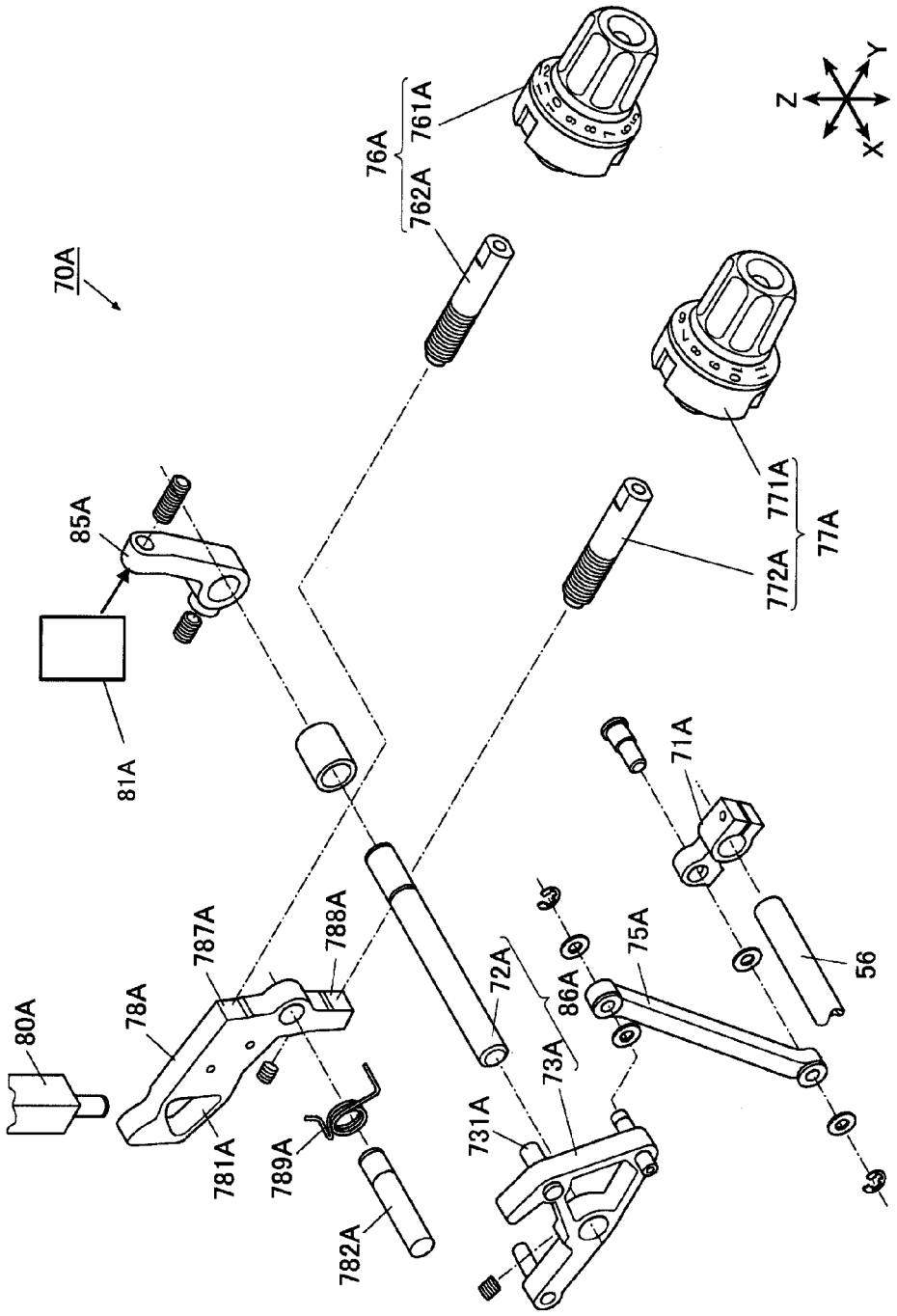

70A
76A
761A
762A
771A
772A
77A
85A
81A
80A
78A
787A
788A
781A
789A
782A
72A
86A
73A
731A
71A
75A
56
Z
Y
X

FIG. 13

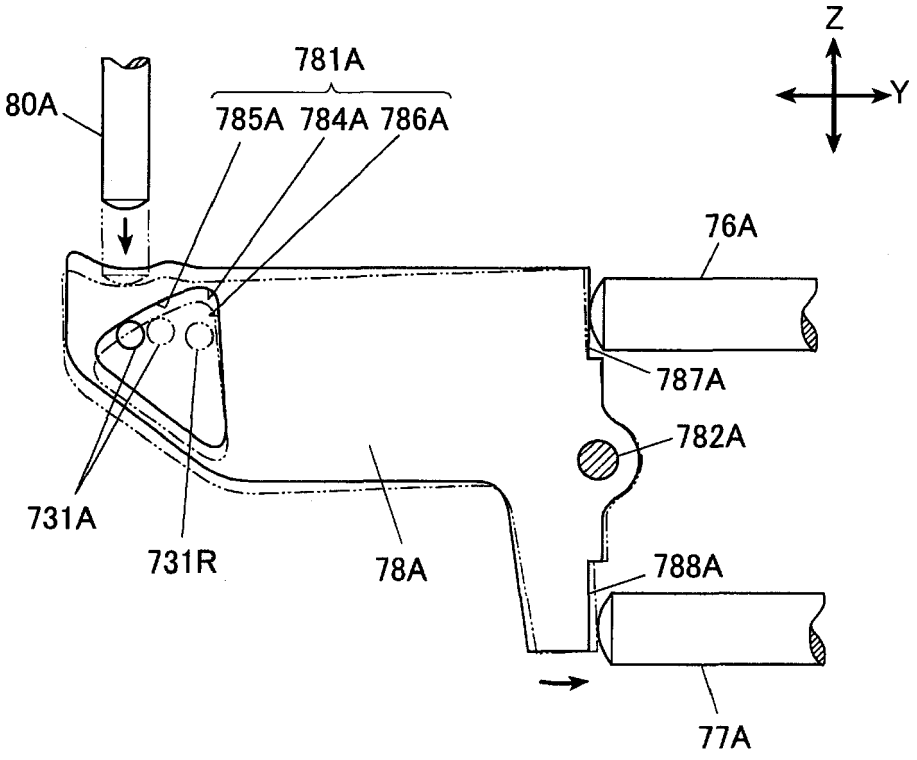

Z
Y
781A
80A
785A 784A 786A
76A
787A
782A
731A
731R
78A
788A
77A

FIG. 14

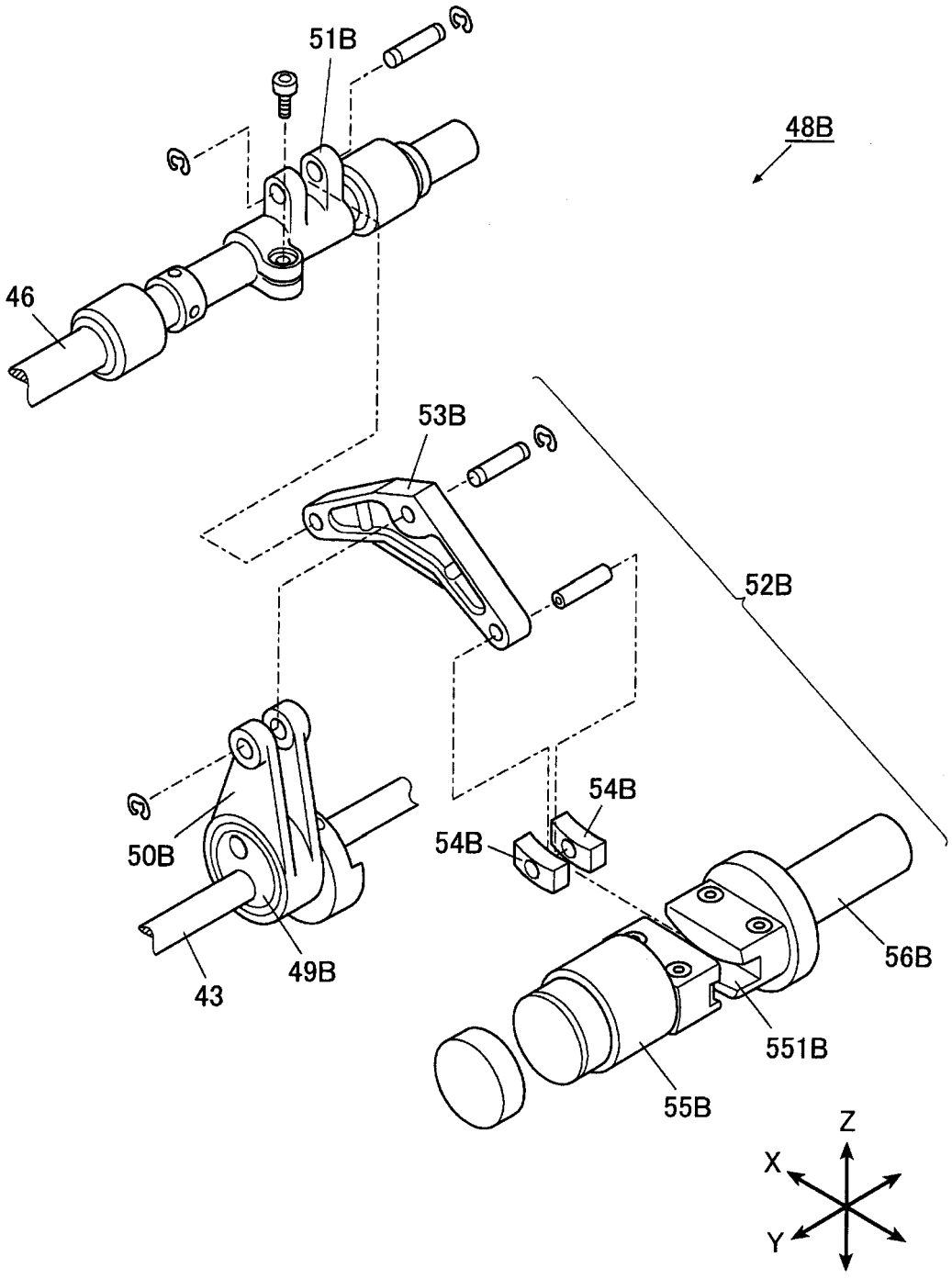


FIG. 15

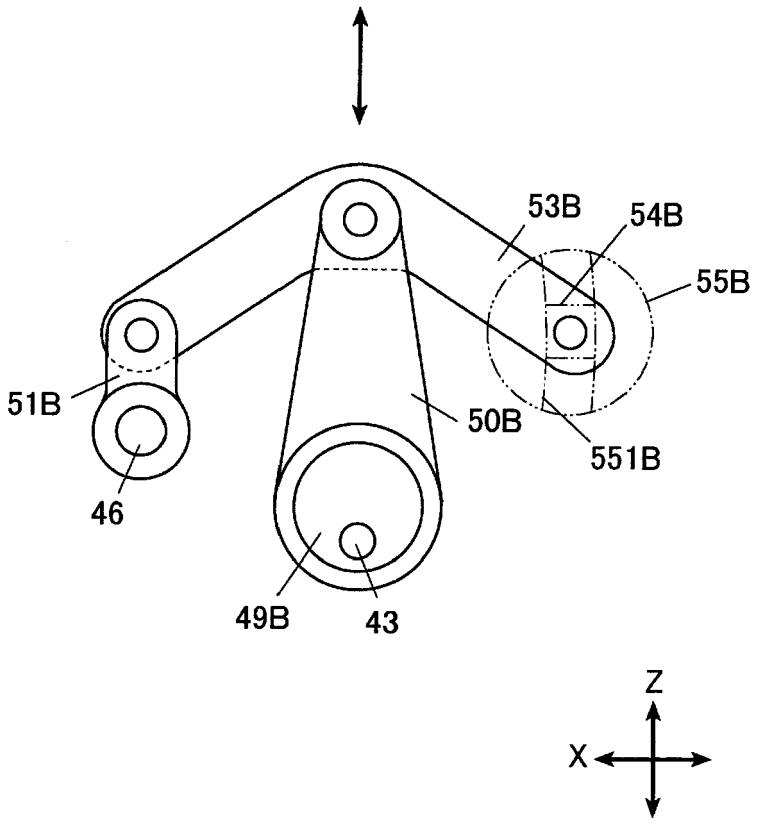
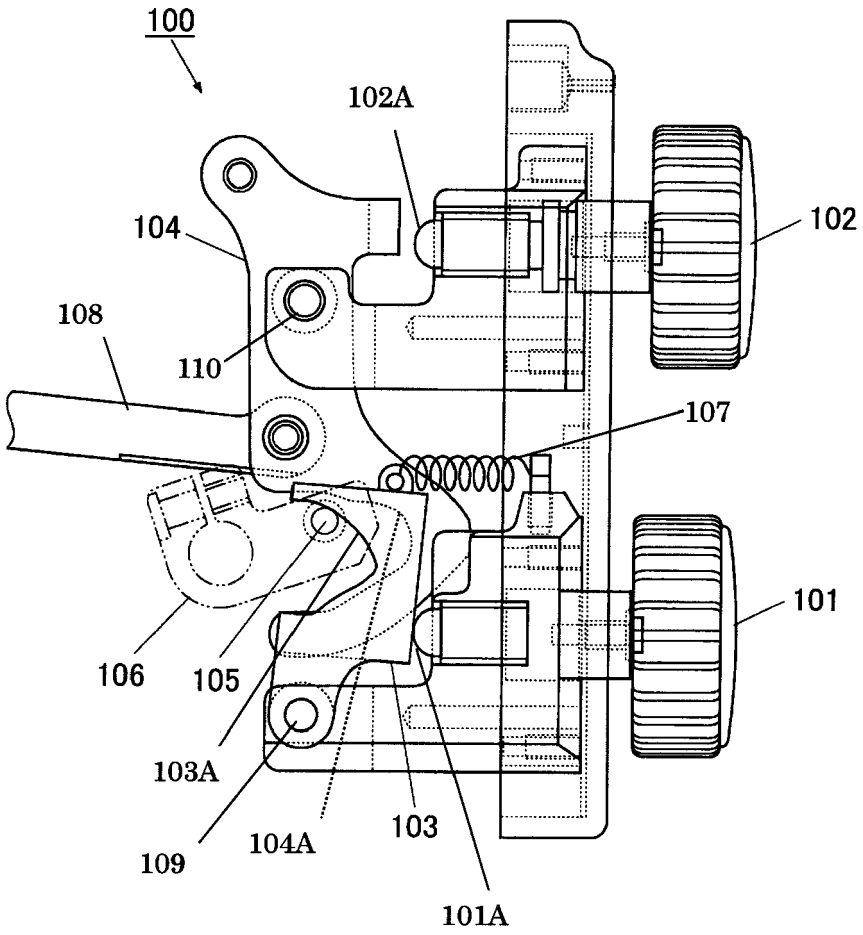


FIG. 16



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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 1760

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 2007 202667 A (JUKI KK) 16 August 2007 (2007-08-16) * abstract; figures 1-10 *	1-4	INV. D05B27/02
A	JP H06 292778 A (BROTHER IND LTD) 21 October 1994 (1994-10-21) * abstract; figures 1-9 *	1-4	
A	EP 2 325 364 A2 (JUKI KK [JP]) 25 May 2011 (2011-05-25) * paragraph [0036] - paragraph [0086]; figures 1-12 *	1-4	
A	CH 290 562 A (VON ORELLI FRANZ [CH]) 15 May 1953 (1953-05-15) * page 1, line 62 - page 3, line 11; figure 1 *	1-4	
A	WO 89/12127 A1 (PFAFF IND MASCH [DE]) 14 December 1989 (1989-12-14) * page 3, line 21 - page 6, line 5; figure 1 *	1-4	TECHNICAL FIELDS SEARCHED (IPC) D05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 May 2013	Herry-Martin, D

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07-05-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2007202667 A	16-08-2007	CN 101012605 A	08-08-2007
		DE 102007004549 A1	06-09-2007
		JP 4823700 B2	24-11-2011
		JP 2007202667 A	16-08-2007
JP H06292778 A	21-10-1994	NONE	
EP 2325364 A2	25-05-2011	CN 102061575 A	18-05-2011
		EP 2325364 A2	25-05-2011
		JP 2011101719 A	26-05-2011
CH 290562 A	15-05-1953	NONE	
WO 8912127 A1	14-12-1989	DE 3819061 C1	23-11-1989
		EP 0417120 A1	20-03-1991
		ES 2014143 A6	16-06-1990
		JP 2730784 B2	25-03-1998
		JP H04504959 A	03-09-1992
		US 5299518 A	05-04-1994
		WO 8912127 A1	14-12-1989

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Patent documents cited in the description

- JP 2007202667 A **[0004]**