(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 565 313 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
13.08.2014 Bulletin 2014/33

(51) Int Cl.:
D05B 55/16 *(2006.01)*

(21) Application number: **12182532.7**

(22) Date of filing: **31.08.2012**

(54) **Double needle sewing machine**

Doppelnadel-Nähmaschine

Machine à coudre à deux aiguilles

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **31.08.2011 JP 2011188268**

(43) Date of publication of application:
06.03.2013 Bulletin 2013/10

(73) Proprietor: **JUKI Corporation**
Tama-shi
Tokyo
206-8551 (JP)

(72) Inventors:
- **Tsukioka, Takashi**
  Tokyo, 206-8551 (JP)
- **Kumon, Satoshi**
  Tokyo, 206-8551 (JP)
- **Yanagisawa, Masato**
  Tokyo, 206-8551 (JP)

(74) Representative: **Hoeger, Stellrecht & Partner Patentanwälte**
Uhlandstrasse 14c
70182 Stuttgart (DE)

(56) References cited:
EP-A1- 2 192 221
DE-B3-102009 004 216
JP-A- 2006 141 706
US-A- 3 438 347
US-A- 4 448 139

EP 2 565 313 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a double needle sewing machine that includes two needle bars having lower ends to which sewing needles are fixed, and forms parallel two seams along a given shape.

[0002] In conventional double needle sewing machines, to form seams in a desired shape, the sewing direction is changed by manually holding and moving a cloth. In this sewing machine, generally, when forming seams at a corner portion, the sewing machine is put into a one-needle state by stopping the up-down movement of a needle bar on the inner side of the corner portion and a seam is formed only by a needle bar on the outer side, and at the corner portion, the cloth is turned around the needle bar on the outer side to form a seam of the outside corner portion, and at a position corresponding to the inside corner portion, the sewing machine is put into a double-needle state so that the needle bar on the inner side moves up and down again.

[0003] In recent years, a double needle sewing machine is being developed for automatically moving a workpiece in the X-Y directions in accordance with sewing pattern data to form two seams along a predetermined shape.

[0004] For example, a related art sewing machine includes a needle bar turning base holding two needle bars such that the needle bars are movable up and down, needle bar turning base being supported by a sewing machine frame so as to be turnable about a vertical axis, and a shuttle base supporting two shuttles such that the shuttles are turnable around the vertical axis. The sewing machine forms two seams along a predetermined shape by controlling a cloth that is moved along the predetermined shape by a cloth holding frame such that the direction in which the two needles are arranged is always orthogonal to the line defining the predetermined shape (see, e.g., KR2008-0089985A).

[0005] In this double needle sewing machine, for sewing at a corner portion, a clutch mechanism for switching the respective needle bars between an up-down movable state and a stopped state and an actuator for making this clutch mechanism perform a switching operation are mounted on the needle bar turning base, and switching between a one-needle state and a double-needle state is performed by operating the actuator during the sewing operation.

[0006] However, in the sewing machine described above, the actuator for switching a clutch mechanism is mounted on the needle bar turning base, so that the turning weight increases and obstructs high-speed sewing. The motor for turning the needle bars may be replaced with a large-sized motor, however, this poses a problem which increases the size and cost of the sewing machine.

[0007] Further, because the actuator is mounted on the needle bar turning base that turns, wiring for energizing the actuator is difficult, and for example, a special component such as a slip ring is required, and this also increases the cost.

[0008] An object of the present invention is to provide a double needle sewing machine that enables smooth turning movements of two needles while enabling automatic switching between a one-needle state and a double-needle state.

[0009] According to an aspect of the present invention, a double needle sewing machine comprises two needle bars that move up and down along the vertical direction, each of the needle bars holding a sewing needle; a needle up-down moving mechanism configured to move the two needle bars up and down; a needle bar turning base supporting the two needle bars such that the needle bars are movable up and down, the needle bar turning base being supported by a sewing machine frame such that the needle bar turning base is turnable about a center line extending along the vertical direction; a needle bar turning mechanism including a turning motor as a drive source and configured to turn the two needle bars via the needle bar turning base; and a clutch mechanism configured to hold the two needle bars and to transmit the up-down movement from the needle up-down moving mechanism to each of the two needle bars individually.

[0010] The sewing machine further comprises an operating member configured to perform a position switching operation on the needle bar turning base to disconnect the transmission to each of the two needle bars through the clutch mechanism individually; an actuator attached to the sewing machine frame in a fixed manner and serving as a drive source for the position switching operation of the operating member; and a differential transmission mechanism configured to receive a drive force from the actuator and to transmit the position switching operation to the operating member.

[0011] The differential transmission mechanism comprises an input member supported on the needle bar turning base such that the input member is turnable about the center line by receiving the drive force from the actuator; an output member supported on the needle bar turning base such that the output member is turnable about the center line to apply the position switching operation to the operating member; a transmission member configured to transmit the turning motion between the input member and the output member such that the turning direction of the turning motion is reversed; and a turning support supported on the needle bar turning base such that the turning support is turnable about the center line, the turning support supporting the transmission member such that the transmission member revolves about the center line.

[0012] The turning motor is attached to the sewing machine frame in a fixed manner. A rotation of the turning motor is transmitted to the needle bar turning base and to the turning support such that the rotation ratio of the needle bar turning base to the turning support is 2:1.

[0013] The sewing machine may include a moving mechanism configured to move a workpiece along a plane orthogonal to the center line, and control means

for controlling the moving mechanism and the turning motor to form two seams along a shape of a predetermined sewing pattern.

[0014] The input member, the output member, and the transmission member may be bevel gears.

[0015] The differential transmission mechanism may further comprise a belt or a gear, and the transmission member may transmit the turning motion between the input member and the output member via the belt or the gear.

[0016] The input member may comprise an input gear, the output member may comprise an output gear, the turning support may comprise a support plate supported on the needle bar turning base such that the support plate is turnable about the center line, and the transmission member may comprise a rotary shaft supported rotatably with respect to the support plate, a driven gear fixed and supported on the rotary shaft and coupled to the input gear, and an interlocking gear fixed and supported on the rotary shaft and coupled to the output gear.

[0017] The turning support may comprise a sprocket coupled to the turning motor via a timing belt, and a support plate provided integrally with the sprocket and supporting the transmission member, and the sprocket may be configured such that the rotation ratio of the needle bar turning base to the sprocket is 2:1.

[0018] The turning support may further comprise a sprocket coupled to the turning motor via a timing belt, the support plate may be provided integrally with the sprocket, and the sprocket may be configured such that the rotation ratio of the needle bar turning base to the sprocket is 2:1.

[0019] The needle bar turning base may comprise a cylindrical upper support portion and a rectangular intermediate portion, the differential transmission mechanism may be disposed on the upper support portion, and the operating member and the clutch mechanism may be disposed on the intermediate portion.

[0020] According to an aspect of the present invention, when the needle bar turning base turns, the turning support supporting the transmission member that transmits the turning motion between the input member and the output member turns half the turning angle of the needle bar turning base. Thus, even when the input member on the actuator side does not turn together with the needle bar turning base so that a turning angle difference is caused between the input member and the needle bar turning base, the transmission member allows the output member to turn by the same turning angle in the same direction as the needle bar turning base. Therefore, the operating member mounted on the needle bar turning base is prevented from being displaced from a proper position by the turning of the needle bar turning base.

[0021] That is, the operating member can be kept in place at a proper position without mounting an actuator for a position switching operation of the operating member on the needle bar turning base.

[0022] Accordingly, the turning weight of the needle bar turning base can be reduced, and a high-speed operation is realized without an increase in size of the motor that performs the turning operation.

[0023] In addition, there is no need to mount an actuator on the needle bar turning base, so that a special component such as a slip ring for energizing the actuator is not necessary, and the sewing machine manufacturing cost can be reduced.

[0024] According to an aspect of the present invention, the workpiece moving mechanism is provided, so that sewing can be performed by automatically moving a workpiece by the moving mechanism, and the needle bar turning base is turned during the sewing operation without affecting the position switching operation of the operating member. That is, holding and releasing of the needle bars can be can be properly carried out by the clutch mechanism during the sewing operation that involves moving of the workpiece.

[0025] In other words, even when two needle bars are turned for forming two seams along the shape of a predetermined sewing pattern, the position switching operation of the operating member is not affected so that holding and releasing of the needle bars can be can be properly carried out by the clutch mechanism.

[0026] According to an aspect of the present invention, bevel gears are used in the differential transmission mechanism, so that the transmission member between the input member and the output member can be realized by one bevel gear, and the component cost can be reduced by the simplified configuration.

[0027] According to an aspect of the present invention, by aligning all the rotation center lines of the input member, the output member, and the sprocket and the gear of the transmission member, these components can be easily arranged on top of one another, so that the differential transmission mechanism can be made slim in the turning center line direction.

[0028] Other aspects and advantages of the present invention will be apparent from the following description, drawings, and the claims.

[0029] The following description of embodiments of the present invention describes the present invention in greater detail with reference to the drawings including:

Fig. 1: a perspective view of a double needle sewing machine according to an embodiment of the present invention;

Fig. 2: a perspective view showing a configuration of a needle bar mechanism inside an arm portion;

Fig. 3: a side view showing a configuration of the periphery of the needle bars;

Fig. 4: a sectional view of a peripheral structure of the needle bar in a section taken along the center of the needle bar;

Fig. 5: a sectional view taken along the line T-T shown in Fig. 3;

Fig. 6: a perspective view of a switching operation mechanism and an operating member;

Fig. 7: a sectional view taken along the line U-U shown in Fig. 3;
Fig. 8: a sectional view taken along the line V-V shown in Fig. 3;
Fig. 9: a sectional view taken along the line W-W shown in Fig. 3;
Fig. 10A: an explanatory view showing a position change of a small sprocket of a needle bar side differential transmission mechanism at the time of a turning operation of the needle bar turning base;
Fig. 10B: an explanatory view showing a position change of an interlocking gear;
Fig. 10C: an explanatory view showing a position change of a differential member;
Fig. 11: a configuration diagram schematically illustrating mechanical structures of a power transmission mechanism and a shuttle side differential transmission mechanism of shuttles;
Fig. 12: a view showing an example of a sewing pattern of two seams;
Fig. 13: a flowchart showing sewing control for forming the sewing pattern shown in
Fig. 12;
Fig. 14A: a perspective view of a needle bar holder support structure;
Fig. 14B: a perspective view of another example of a needle bar holder support structure;
Fig. 14C: a plan view of another example of a needle bar holder support structure;
Fig. 15: a control block diagram of the present embodiment;
Fig. 16A: a side view of the needle bar; and
Fig. 16B: a front view of the needle bar. A double needle sewing machine 1 according to an embodiment of the present invention is an electronic cycle sewing machine which includes a holding frame 81 that holds a cloth as a workpiece to be sewn, and forms two seams along a shape pattern based on predetermined sewing data on the cloth held by the holding frame 81 by moving the holding frame 81 relative to two sewing needles 11.

[0030] In the following description, the directions orthogonal to the horizontal direction are defined as an X-axis direction (left-right direction) and a Y-axis direction (front-rear direction), and the direction orthogonal to the X-axis direction and the Y-axis direction is defined as a Z-axis direction.

[0031] The double needle sewing machine 1 includes a sewing machine frame 101, a needle bar mechanism shown in Fig. 2, a shuttle mechanism shown in Fig. 11, and a cloth moving mechanism 80 (an example of a moving mechanism) that arbitrarily moves and positions a cloth along the X-Y plane by holding the cloth.

Sewing Machine Frame

[0032] As shown in Fig. 1, the double needle sewing machine 1 includes a sewing machine frame 101 having a substantially U shaped external form when viewed from the X-axis direction. The sewing machine frame 101 includes an arm portion 101a extending in the Y-axis direction, a bed portion 101b that is opposed to the arm portion 101a below the arm portion and has a bed surface flat along both X-axis and Y-axis directions, and a vertical drum portion 101c that joins the arm portion 101a and the bed portion 101b.

[0033] As shown in Fig. 2, in the arm portion 101a, an upper shaft 22 that is disposed along the Y-axis direction inside the arm portion 101 a and supported rotatably around an axis on the casing of the arm portion 101a, and a stitching motor 21 that is fixed and supported onto the casing of the arm portion 101a inside or outside the arm portion 101a, and has an output shaft (not illustrated) directly coupled to one end portion of the upper shaft 22 to apply a rotative force thereto, are provided.

Needle Bar Mechanism

[0034] The needle bar mechanism includes an upper metal M1 and a lower metal M2 that are fixed to the arm portion 101a, two needle bars 12R and 12L that hold sewing needles 11, respectively, on the lower end portions thereof and move up and down, a needle up-down moving mechanism 20 that moves the sewing needles up and down by using a stitching motor 21 as a drive source, a needle bar turning base 15 that supports the two needle bars 12R and 12L movably up and down, a needle bar turning mechanism 30 that turns the two needle bars 12R and 12L around a center line C along the Z-axis direction via the needle bar turning base 15, a clutch mechanism 50 that can be switched between a holding state where the clutch mechanism holds the two needle bars 12R and 12L individually to transmit an up-down movement of the needle up-down moving mechanism 20 and a state where the holding state is released, a stopper mechanism 90 that locks (holds) the needle bar 12R or 12L in the state where transmission by the clutch mechanism 50 is released, and a switching operation mechanism 60 that switches the clutch mechanism 50 between the holding state and the releasing state.

[0035] In the upper and lower metals M1 and M2, support holes (not illustrated) in which cylindrical portions of the upper and lower ends of the needle bar turning base 15 are fitted rotatably are formed along the axis, respectively.

[0036] As shown in Fig. 16, in each of the intermediate portions of the needle bars 12R and 12L, a groove portion 121 along the Z-axis direction is formed. In the upper and lower end portions of the groove portion 121, groove-shaped engagement holes 122 and 123 that cross the groove portion 121 and are along the horizontal direction (Y-axis direction) are formed. The lower engagement hole 122 is for holding the needle bar 12L (12R) by the clutch mechanism 50, and the upper engagement hole 123 is for holding the needle bar 12L (12R) by the stopper

mechanism 90.

[0037] Inside the groove portion 121, an oscillation plate 124 is supported by the needle bar 12R or 12L so as to oscillate around the intermediate portion, and is disposed so that the upper and lower end portions thereof are opposed to the engagement holes 122 and 123, respectively.

Needle Bar Turning Base

[0038] As shown in Fig. 2, the needle bar turning base 15 includes an upper support portion 15A and a lower support portion (not illustrated) that are cylindrical, respectively, and an intermediate portion 15C.

[0039] The upper support portion 15A is fitted rotatably in the upper metal M1 so that the upper end thereof projects, and the lower support portion is fitted turnably in the lower metal M2.

[0040] Through the upper support portion 15A and the lower support portion, through holes 156L and 156R are formed along the Z-axis direction at positions across the turning center C at equal distances to the turning center C of the needle bar turning base 15, and the needle bars 12R and 12L are inserted through the through holes 156L and 156R movably up and down.

[0041] The intermediate portion 15C has rectangular portions 151 formed by shaping the upper and lower ends into rectangular shapes, and the portion between the upper and lower rectangular portions 151 is notched into a substantially L shape in a cross sectional view, and in one side wall portion 153 thereof, a slot 155 along the Z-axis direction is formed.

[0042] On the upper end face of the upper rectangular portion 151, a guide portion 151A rises in parallel to the tangential direction (Y-axis direction) of an output gear 632 described later at a predetermined distance to the output gear, and a groove portion 151 a along the tangential direction is formed on a surface opposed to the output gear 632.

[0043] Through the upper rectangular portion 151, a through hole 157 is formed along the X-axis direction, and a stopper member 91 of the stopper mechanism 90 is inserted therein.

Needle Up-Down Moving Mechanism

[0044] The needle up-down moving mechanism 20 includes the stitching motor 21 and the upper shaft 22, and includes a needle bar crank 23 fixed to the other end portion of the upper shaft 22, a crank rod 24 having one end coupled to an eccentric position of the needle bar crank 23, an annular needle bar holder 25 that is coupled to the intermediate portions in the axial directions of the needle bars 12R and 12L via the clutch mechanism 50 and has an outer peripheral groove 25a formed on the outer peripheral surface, and an annular member 26 that fits in the outer peripheral groove 25a of the needle bar holder 25 and holds the needle bar holder 25 turnably around the Z axis.

[0045] The rotation of the upper shaft 22 is converted into up-down reciprocating movement by the needle bar crank 23 and the crank rod 24 and transmitted to the needle bar holder 25 and the annular member 26.

[0046] The annular needle bar holder 25 is disposed so as to allow the intermediate portion 15C of the needle bar turning base 15 to be inserted into a central opening 25b, and is fixed so that two pivot shafts 251 and 251 project to the inside of the central opening 25b along the Y-axis direction. One pivot shaft 251 penetrates through the slot 155 of the needle bar turning base 15 and projects inward. When the two pivot shafts 251 and 251 are coupled to the needle bars 12R and 12L via the clutch mechanism 50, the needle bars 12R and 12L are movable up and down integrally with the needle bar holder 25.

[0047] The outer peripheral groove 25a is formed across the entire circumference of the needle bar holder 25, and the annular member 26 fits in the outer peripheral groove 25a slidably in the circumferential direction.

[0048] The annular member 26 has a half-ring shape, and on both ends thereof, shaft portions 26a and 26b are formed to project radially outward. One shaft portion 26a penetrates through the lower end portion of the crank rod 24 turnably around the Y-axis direction and projects its tip end, and on the projecting end, a rectangular square piece 241 is axially supported. On the other shaft portion 26b, a rectangular square piece 261 is supported rotatably around the Y-axis direction.

[0049] The square pieces 241 and 261 fit in guide grooves (not illustrated) provided along the vertical direction (Z-axis direction) on the casing of the arm portion 101a, respectively, and accordingly, the annular member 26 and the needle bar holder 25 are guided in the vertical direction movably up and down while being kept horizontally.

[0050] The annular member 26 may have an arc shape shaped by notching a part of a circle, or may have an entire circular shape if the fitting performance is ignored.

Clutch Mechanism

[0051] The clutch mechanism 50 shown in Fig. 4 basically has the same configuration as that disclosed in JP2006-141706A, and following are brief description thereof.

[0052] The clutch mechanism 50 includes a holding body 51 having two insertion holes formed in the Z-axis direction through which the two needle bars 12R and 12L are inserted, two clutch members 52 to be inserted into circular support holes made to penetrate from the front surface of the holding body 51 to the insertion holes, two driven links 53 that advance and retreat the clutch members 52 individually, two pressing springs 54 that apply moving forces in the forward advancing direction to the clutch members 52 individually via the driven links 53, two lock claws 55 that lock the clutch members 52 in a retreated state (at withdrawn positions), respectively, two

pressing springs 56 that press the lock claws 55 in locking directions, respectively, and a release pin 57 into which operations for releasing the locks of the lock claws 55 can be input from the outside.

[0053] The two insertion holes of the holding body 51 are formed along the X-axis direction, and support the substantially cylindrical clutch members 52 slidably along the X-axis direction.

[0054] The rear end portion of the clutch member 52 is coupled to the driven link 53, and the driven link 53 presses the clutch member 52 toward the needle bar 12 side by the pressing spring 54. The clutch member 52 is shaped so that its tip end portion can be inserted into the engagement hole 122 of the needle bar 12, and the pressing force of the pressing spring 54 keeps an engaged state between the clutch member 52 and the engagement hole 122 of the needle bar 12, and becomes a holding force that enables the clutch mechanism 50 to hold the needle bar 12.

[0055] When the upper end portion of the driven link 53 is pressed downward, it retreats the clutch member 52 and releases the holding state of the needle bar 12 by the clutch mechanism 50.

[0056] When the clutch member 52 retreats, the lock claw 55 that is normally pressed upward by the pressing spring 56 locks the tip end portion of the clutch member 52 and restricts the clutch member 52 from moving forward. Two lock claws 55 can release the locked states of the clutch members 52 when the lock claws are pressed downward by the release pin 57.

Switching Mechanism

[0057] When the needle bar 12 reaches the top dead point of the up-down movement, the upper end portion of the driven link 53 can press the projecting portion 161 of the operating member 16 supported slidably in the Y-axis direction on the upper end portion of the intermediate portion 15C of the needle bar turning base 15 by colliding with the projecting portion.

[0058] As shown in Fig. 6, the operating member 16 has rack teeth 16A formed on the upper portion one-side surface so as to mesh with an output gear 632 described later, and has a projecting portion 161 formed projecting downward from the tip end of an arm 16B extending downward in a substantially L shape. The operating member 16 has a convex portion 162 formed along the Y-axis direction on the side opposite to the rack teeth 16A, and this convex portion 162 fits in the groove portion 151a of the needle bar turning base 15. Accordingly the operating member 16 is supported on the needle bar turning base 15 slidably along the tangential direction (Y-axis direction) of a circle circumscribed around the output gear 632.

[0059] The operating member 16 is slidable (movable) along the groove portion 151a to a position P1 at which the projecting portion 161 collides with the driven link 53 that releases the holding state of the left needle bar 12L, a position P3 at which the projecting portion 161 collides with the driven link 53 that releases the holding state of the right needle bar 12R, and a position P2 at which the projecting portion 161 collides with the release pin 57, as shown in Fig. 3 by the solenoid 61 of the position switching mechanism 60.

[0060] The operating member 16 releases the holding state where the respective needle bars are held by the clutch mechanism 50 by position switching on the needle bar turning base 15.

[0061] Accordingly, the two needle bars 12R and 12L can be held by the clutch mechanism 50 and released individually.

Stopper Mechanism

[0062] The stopper mechanism 90 includes, in Fig. 4, a stopper member 91 that is inserted slidably in the axial direction into a through hole 157 formed in the upper rectangular portion 151 of the intermediate portion 15C, a pressing spring 92 that presses the stopper member 91 toward the needle bar 12L side, and a cover body 93 that supports the pressing spring 92 on the rear side and covers and closes the insertion hole of the stopper member 91.

[0063] The tip end portion of the stopper member 91 is shaped so as to be inserted into the engagement hole 123 of the needle bar 12, and the pressing force of the pressing spring 92 keeps an engaged state between the stopper member 91 and the engagement hole 123 of the needle bar 12 and becomes a holding force enabling the stopper mechanism 90 to hold the needle bar 12.

[0064] However, the pressing force of the pressing spring 92 of the stopper member 91 is set to be sufficiently smaller than that of the pressing spring 54 of the clutch member 52, and unless the clutch member 52 is in a releasing state, the pressing spring 92 yields to pressing of the clutch member 52 due to the oscillation plate 124, so that the needle bar 12 is not held by the stopper mechanism 90. Specifically, the stopper mechanism 90 holds only the needle bar 12 that has been released from holding by the clutch mechanism 50 according to collision of the driven link 53 with the projecting portion 161 of the operating member 16.

Needle Bar Turning Mechanism

[0065] The needle bar turning mechanism 30 includes, as shown in Fig. 3 and Fig. 5, a turning motor (needle bar turning motor) 31 serving as a drive source of turning of the needle bar turning base 15, and a transmission mechanism that transmits turning of the turning motor 31 to the needle bar turning base 15.

[0066] The turning motor 31 is disposed inside the arm portion 101a so that the motor shaft (not illustrated) is along the Z-axis direction, and is fixed to the casing of the arm portion 101a.

[0067] The transmission mechanism includes a main

driving sprocket 32 fixed to the motor shaft of the turning motor 31, a driven sprocket 33 fixed to the upper end portion of the upper support portion 151 of the needle bar turning base 15, and a timing belt 34 wound between the main driving sprocket 32 and the driven sprocket 33.

[0068] When the turning motor 31 is driven, the needle bar turning base 15 is turned around its turning center line C at a transmission ratio of 1 to 1 via the main driving sprocket 32, the timing belt 34, and the driven sprocket 33.

Switching Operation Mechanism

[0069] The switching operation mechanism 60 is described with reference to Fig. 6 to Fig. 9.

[0070] The switching operation mechanism 60 is a mechanism for transmitting and applying a position switching operation to the operating member 16 mounted on the needle bar turning base 15.

[0071] This switching operation mechanism 60 includes a solenoid 61 (an example of an actuator) that can stop at three positions and is fixed and mounted inside the arm portion 101a, a rack member 62 provided on the plunger of the solenoid 61, and a needle bar side differential transmission mechanism 63 that transmits a position switching operation from the solenoid 61 to the operating member 16 through the rack member 62.

[0072] The solenoid 61 is controllable to selectively stop at three positions, and each of the stop positions correspond to the switching positions P1 to P3 of the operating member 16 described above.

[0073] The rack member 62 can be advanced and retreated along the Y-axis direction by the solenoid 61, and has rack teeth formed along the advancing and retreating direction.

[0074] When the rack member 62 is stopped at each position by the solenoid 61, the projecting portion 161 of the operating member 16 must be stopped at each position of P1 to P3 described above.

[0075] On the other hand, the operating member 16 is mounted on the needle bar turning base 15 that turns during the sewing operation, however, the solenoid 61 that is a drive source for position switching of the operating member 16 is fixed to the sewing machine frame.

Differential Transmission Mechanism

[0076] The needle bar side differential transmission mechanism 63 (a differential transmission mechanism) includes an input gear 631 (an example of an input member) that turns in response to an input of a drive force from the solenoid 61 via the rack member 62, an output gear 632 (an example of an output member) that applies a position switching operation to the operating member 16 according to the turning, a transmission member 64 that reverses and transmits a rotative force between the input gear 631 and the output gear 632, and a turning support 65 (shown in Fig. 3) that supports the transmission member 64 so that the transmission member revolves around the turning center line C of the needle bar turning base 15.

[0077] The input gear 631, the output gear 632, and the turning support 65 all are supported turnably around the turning center line C by the upper support portion 15A formed on the upper end portion of the needle bar turning base 15. The input gear 631 has a first gear portion 631a on the upper side and a second gear portion 631b on the lower side, and the gear portions have tooth profiles different from each other, however, they are formed integrally. The rack member 62 meshes with the first gear portion 631a, and a belt 644 is wound around the second gear portion 631b (input sprocket).

[0078] The input gear 631 is positioned below the driven sprocket 33 described above, and as shown in Fig. 7, the upper side first gear portion 631a formed on the outer peripheral surface meshes with the rack member 62 described above. Therefore, the input gear 631 is supported turnably around the turning center with respect to the needle bar turning base 15 and coupled to the actuator 61, and is rotated in conjunction with the actuator 61. The input gear 631 can turn independently of the needle bar turning base 15.

[0079] The needle bar side differential transmission mechanism 63 can keep the position of the operating member 16 with respect to the needle bar turning base 15 constant even when a relative turning angle difference is caused between the needle bar turning base 15 and the input gear 631 by the turning operation of the needle bar turning base 15.

[0080] The turning support 65 shown in Fig. 3 and Fig. 7 includes a support plate 651 that supports the transmission member 64 rotatably around the Z axis, and a sprocket 652 (not illustrated in Fig. 6) which is fixed to the upper surface of the support plate 651 and into which turning is input by the turning motor 31.

[0081] The support plate 651 is circular and positioned below the input gear 631, and is supported rotatably on the upper support portion 15A of the needle bar turning base 15 shown in Fig. 7.

[0082] The above-described transmission member 64 includes a rotary shaft 641 along the Z-axis direction, a small sprocket (driven gear) 642 fixed to the upper end portion of the rotary shaft 641, and an interlocking gear 643 fixed to the lower end portion of the rotary shaft 641.

[0083] The support plate 651 supports the rotary shaft 641 of the transmission member 64 rotatably, and on the upper surface side thereof, the small sprocket 642 is disposed, and on the lower surface side, the interlocking gear 643 is disposed. On the upper surface side of the support plate 651, the timing belt 644 is wound around the small sprocket 642 and the second gear portion 631b of the input gear 631, and the small sprocket 642 and the input gear 631 rotate in conjunction with each other in the same rotating direction. When the small sprocket 642 rotates, the interlocking gear 643 joined by the rotary shaft 641 also rotates in the same direction by the same

angle amount.

[0084] The sprocket 652 has an opening at the center portion, and the input gear 631 is inserted therein with play.

[0085] The sprocket 652 is fixed to the upper surface of the support plate 651 by screws not illustrated. The above-described small sprocket 642 is disposed inside a recessed portion formed on the upper surface of the support plate 651, and is coupled to the second gear portion 631b of the input gear 631 below the sprocket 652 by the belt 644.

[0086] This sprocket 652 is coupled to the main driving sprocket 32 provided in the turning motor 31 of the needle bar turning mechanism 30 by a timing belt 653.

[0087] Specifically, when the turning motor 31 is driven, the turning motor turns the driven sprocket 33 that turns the needle bar turning base 15 and the sprocket 652 that turns the turning support 65 simultaneously. The effective diameters of the driven sprocket 33 and the sprocket 652 are set so that the rotation angle amount to be input into the turning support 65 from the turning motor 31 becomes just 1/2 of the rotation angle amount to be input into the needle bar turning base 15. The turning directions of these are set to the same direction. Specifically, when the turning motor 31 inputs a turning operation into the needle bar turning base 15, a turning angle that is half the turning angle to be input into the needle bar turning base 15 is input into the turning support 65.

[0088] Thus, by applying turning to the sprocket 652 from the turning motor 31, the transmission member 64 supported by the support plate 651 can be revolved around the turning center line C.

[0089] The output gear 632 is positioned below the support plate 651, and meshes with the interlocking gear 643 of the transmission member 64 as shown in Fig. 9. The effective diameter ratio of the input gear 631 to the small sprocket 642 is designed to match the effective diameter ratio of the output gear 632 to the interlocking gear 643.

[0090] Accordingly, in a state where the turning support 65 is not rotated, when rotation of a predetermined angle is input into the input gear 631, the output gear 632 rotates by the same angle in the reverse rotating direction.

[0091] Hereinafter, an operating state of the needle bar side differential transmission mechanism 63 when the needle bar turning base 15 turns is described with reference to Fig. 10A to Fig. 10C.

[0092] Here, a case where the needle bar turning base 15 turns 180° clockwise while the solenoid 61 is in a stopped state is illustrated.

[0093] First, as shown in Fig. 10A, when 180° clockwise turning is applied to the needle bar turning base 15 by the turning motor 31, 90° turning in the same direction is applied to the turning support 65. Accordingly, the small sprocket 642 revolves 90° clockwise. At this time, the small sprocket 642 is coupled to the input gear 631 being stopped by the belt 644, so that the small sprocket 642 itself rotates counterclockwise by an angle of (diameter of input gear 631/diameter of small sprocket) x 90°.

[0094] Accordingly, as shown in Fig. 10B, the interlocking gear 643 revolves and rotates in the same manner as the small sprocket 642. As a result, to the output gear 632 meshing with the interlocking gear 643, clockwise rotation (= 90°) equivalent to the revolving movement of the interlocking gear 643 and clockwise rotation (= 90°) according to rotation of the interlocking gear 643 are applied, and the output gear 632 turns 180° clockwise.

[0095] Specifically, when the needle bar turning base 15 is set as a reference, the input gear 631 turns 180° counterclockwise relative to the needle bar turning base 15, however, the output gear 632 does not turn with respect to the needle bar turning base 15.

[0096] As a result, as shown in Fig. 10C, no relative angle change is caused between the output gear 632 and the operating member 16, so that the operating member 16 does not move on the needle bar turning base 15, and the projecting portion 161 thereof can be kept at a fixed position.

[0097] Even when the solenoid 61 operates and turns the input gear 631 during turning of the needle bar turning base 15, the same operation as described above is applied, so that the projecting portion 161 of the operating member 16 can be positioned at a proper position according to the operation position of the solenoid 61.

Shuttle Mechanism

[0098] The shuttle mechanism includes two shuttles 13 and 13 for interlacing lower threads with upper threads inserted through the sewing needles 11 and 11, a shuttle side differential transmission mechanism 40 that includes an input shaft 41 and an output shaft 42 for transmitting power from the stitching motor 21 to the shuttles 13 and 13 and can change and adjust a phase difference between these shafts, and a power transmission mechanism 70 that transmits a torque from the stitching motor 21 to the input shaft 41 of the shuttle side differential transmission mechanism 40.

Shuttle

[0099] Two shuttles 13 and 13 are so-called full rotary vertical shuttles, and are disposed at diagonal positions around the turning center line C of the needle bar turning base 15 below the throat plate NP. The shuttles 13 and 13 are disposed at the same distance to each other as that between the sewing needles 11 and 11 so as to capture upper threads from the corresponding sewing needles 11 and 11.

[0100] On the lower portion of each shuttle 13, a pivot shaft 14 is provided, and each pivot shaft 14 is supported rotatably around the Z axis by a shuttle base not illustrated. The shuttle base is fixed and mounted on the upper portion of the turning base 43 of the shuttle side differential transmission mechanism 40, can revolve about the

center line C together with the turning base 43, and accordingly, two shuttles 13 and 13 turn and move about the center line C to follow the revolving movements of the two needle bars 12R and 12L according to the needle bar turning base 15.

Power Transmission Mechanism

[0101] As shown in Fig. 11, the power transmission mechanism 70 of the two shuttles 13 and 13 includes a main driving sprocket 751 coupled to the output shaft of the drive motor 71 that is a rotation drive source of the shuttles 13, a driven sprocket 752 mounted on the input shaft 41 of the shuttle side differential transmission mechanism 40, and a timing belt 753 wound around the sprockets 751 and 752 inside the bed portion 101b. Accordingly, the rotation of the drive motor 71 is transmitted to the shuttles 13 via the shuttle side differential transmission mechanism 40.

Shuttle Side Differential Transmission Mechanism

[0102] The shuttle side differential transmission mechanism 40 is supported on a support frame attached to one end portion of the bed portion 101b below the needle bars 12 and integrated with the sewing machine frame 101.

[0103] The shuttle side differential transmission mechanism 40 has a function of transmitting a rotative force from the drive motor 71 transmitted from the power transmission mechanism 70 to the shuttles 13 to rotate the shuttles around the pivot shafts 14, a function of turning the positions of the shuttles 13 about the center line C, and a function of correcting changes of the phases around the pivot shafts 14 according to turning of the positions of the shuttles 13.

[0104] Specifically, the shuttle side differential transmission mechanism 40 includes the input shaft 41 into which a rotative force is input from the stitching motor 21 via the power transmission mechanism 70, the output shaft 42 that outputs the rotative force transmitted from the input shaft 41 to the shuttle 13 side, an intershaft transmission portion 44 that has a support frame 441 for supporting the input shaft 41 and the output shaft 42 and transmits the rotative force between these shafts, a shuttle transmission portion 45 that transmits the rotative force to the pivot shafts 14 of the shuttles 13 from the output shaft 42, a turning base 43 that holds the shuttle base and is supported turnably about the center line C by the sewing machine frame, and a turning application mechanism 46 that applies a turning operation to the support frame 441 and the turning base 43.

[0105] The shuttle transmission portion 45 includes a main driving sprocket 451 fixed and mounted to the upper end portion of the output shaft 42 projecting from the upper end portion of the turning base 43, a driven sprocket 452 that is adjacent to the main driving sprocket 451 and is fixed and mounted to the lower end portion of the pivot shaft 14 of one shuttle 13, a driven sprocket 453 that is adjacent to the main driving sprocket 451 on the side opposite to the driven sprocket 452 and is fixed and mounted to the lower end portion of the pivot shaft 14 of the other shuttle 13, a tension pulley 454 axially supported around the Z axis on the upper surface of a top plate portion 431, and a double-toothed timing belt 455 provided around these sprockets and tension pulley 454.

[0106] With this configuration, when the main driving sprocket 451 rotates together with the output shaft 42, the driven sprockets 452 and 453 are rotated in a direction opposite to that of the main driving sprocket 451 via the double-toothed timing belt 455.

[0107] In the intershaft transmission portion 44, the support frame 441 is supported turnably about the center line C by the turning base 43 inside the turning base 43, and the support frame 441 supports the input shaft 41 and the output shaft 42 rotatably about the center line C.

[0108] The intershaft transmission portion 44 includes a first bevel gear 442 fixed and mounted to the opposed end portion of the input shaft 41, a second bevel gear 443 fixed and mounted to the opposed end portion of the output shaft 42, and a transmission body 445 that axially supports a transmission bevel gear 444 that meshes with both of the first and second bevel gears 442 and 443 opposed to each other.

[0109] With this structure, the intershaft transmission portion 44 forms a so-called differential gear mechanism.

[0110] The turning application mechanism 46 is fixed and mounted to the lower end portion of the support frame 441, and includes a first driven sprocket 461 into which a turning force for the support frame 441 is input, a second driven sprocket 462 which is fixed and mounted to the lower end portion of the turning base 43 and into which a turning force for the turning base 43 is input, a turning motor 463 that becomes a turning drive source of the support frame 441 and the turning base 43, a first main driving sprocket 464 that inputs a turning force from the turning motor 463 into the first driven sprocket 461, a second main driving sprocket 465 that inputs a turning force from the turning motor 463 into the second driven sprocket 462, a timing belt 466 wound between the first main driving sprocket 464 and the first driven sprocket 461, and a timing belt 467 wound between the second main driving sprocket 465 and the second driven sprocket 462.

[0111] The first driven sprocket 461 and the second driven sprocket 462 have effective diameters set to be the same, and the first main driving sprocket 464 and the second main driving sprocket 465 have effective diameters the ratio of which is set to 1 to 2. Specifically, a turning angle that is applied to the support frame 441 by driving the turning motor 463 becomes half the turning angle of the turning base 43.

[0112] Further, the first main driving sprocket 464 and the second main driving sprocket 465 are both fixed and mounted to the output shaft of the turning motor 463, so that these sprockets 464 and 465 are rotated always si-

multaneously in conjunction with each other.

[0113] Specifically, this intershaft transmission portion 44 is structured to obtain the same operation as that of the needle bar side differential transmission mechanism 63.

[0114] The input gear 631 and the output gear 632 of the needle bar side differential transmission mechanism 63 correspond to the first bevel gear 442 and the second bevel gear 443 of the intershaft transmission portion 44, and the transmission member 64 of the needle bar side differential transmission mechanism 63 corresponds to the transmission bevel gear 444 of the intershaft transmission portion 44. The needle bar turning base 15 corresponds to the turning base 43, and the support frame 441 corresponds to the turning support 65.

[0115] Accordingly, at the time of driving of the shuttles 13 and 13, when the two shuttles 13 and 13 are turned about the center line C by the turning base 43, the support frame 441 turns half the turning angle of the shuttles, and the transmission bevel gear 444 turns together with the support frame 441, so that the phase shift caused by turning of the shuttles 13 and 13 can be corrected with respect to the output shaft 42 side.

[0116] Specifically, without causing phase shift of the shuttles 13, the shuttles 13 can be turned.

Cloth Moving mechanism

[0117] As shown in Fig. 1, the cloth moving mechanism 80 includes a holding frame 81 that holds a workpiece on the upper surface of the bed portion 101b, a support arm 82 that supports the holding frame 81 movably up and down, an X-axis motor XM (not illustrated) that moves the holding frame 81 in the X-axis direction via the support arm 82, and a Y-axis motor YM that moves the holding frame 81 in the Y-axis direction via the support arm 82.

[0118] With this configuration, the cloth moving mechanism 80 can move and position the workpiece to an arbitrary position on the X-Y plane via the holding frame 81, so that needles can be made to fall to arbitrary positions for each stitch, and free stitches can be formed.

Controller

[0119] A controller 200 is described with reference to the control block diagram of the present embodiment shown in Fig. 15.

[0120] The controller 200 includes a ROM storing in advance such as data on position coordinates showing a sewing pattern and programs for executing a sewing operation, a RAM that stores various set data input through an operation panel (not illustrated) attached to the sewing machine 1, and a CPU that executes a sewing operation based on the data and programs.

[0121] To the controller 200, a stitching motor drive circuit MD1 that drives the stitching motor 21 at a driving speed corresponding to a sewing pattern or stops it, an X-axis motor drive circuit MD2 that drives and stops the X-axis motor XM, a Y-axis motor drive circuit MD3 that drives and stops the Y-axis motor YM, a shuttle turning motor drive circuit MD4 that drives and stops the turning motor 46 (shuttle turning motor), a needle bar turning motor drive circuit MD5 that drives and stops the turning motor 31 (needle bar turning motor), and a switching solenoid drive circuit SM that drives the solenoid 61 (switching solenoid) to the three positions described above are connected. Into the motor drive circuits MD1 to MD5, feedback signals from the motors are input, and the rotation phases (rotation positions) of the motors can be recognized.

Sewing Operation of Sewing Machine

[0122] According to the flowchart shown in Fig. 13, a sewing operation for forming a sewing pattern of two seams shown in Fig. 12 is described. The flowchart shown in Fig. 13 is performed by the CPU of the controller 200.

[0123] First, driving amounts of the X-axis motor XM and the Y-axis motor YM for making one sewing needle 11 fall onto needle fall positions for the respective stitches are calculated from the position coordinate data (Step S1).

[0124] Further, from the data of the driving amounts of the X-axis motor XM and the Y-axis motor YM for the respective stitches, the sewing advancing directions for the respective stitches are obtained, and the turning angles are calculated so that the needle bars 12R and 12L and the shuttles 13 and 13 are arranged in directions orthogonal to the advancing directions (Step S3).

[0125] Then, the stitching motor 21 is driven to start sewing with the sewing machine, and the X-axis motor XM and the Y-axis motor YM are driven to advance sewing in the predetermined sewing direction for each stitch, and the turning motors 31 and 463 are controlled so that the needle bars 12R and 12L and the shuttles 13 and 13 are arranged in the planned direction for each stitch (Step S5).

[0126] When the current sewing position is any of the determined corner points A1 to A4 of the sewing pattern (Step S7), the position of the solenoid 61 is controlled to release holding of the needle bar 12 that performs inner-side sewing by the clutch mechanism 50, and the sewing machine is switched into a one-needle sewing state (Step S9).

[0127] Accordingly, sewing is performed with only one needle bar 12R or 12L that is on the outer side (Step S11). Specifically, effective one needle bar and the turning motors 31 and 463 are driven to turn 90° to form stitches at a corner portion with one needle, and thereafter, the position of the solenoid 61 is controlled to restart holding of both needle bars 12R and 12L by the clutch mechanism 50, and accordingly, the sewing machine is switched into a two-needle sewing state (Step S 13).

[0128] Then, sewing with both needle bars 12R and

12L is performed, and it is judged whether sewing has reached the final stitch of the sewing pattern (Step S 15), and when sewing reaches the final stitch, driving of all motors are stopped and the sewing operation is ended. In the case where the final stitch has not been reached, the process returns to Step S5 and the sewing operation is continued.

Advantages of Embodiment of Invention

[0129] In the double needle sewing machine 1, as described above, in the differential transmission mechanism 63 that transmits a position switching operation from the solenoid 61 to the operating member 16, the turning support 65 supporting the transmission member 64 that reverses and transmits a rotative force between the input gear 631 and the output gear 632 turns half the turning angle of the needle bar turning base 15 when the needle bar turning base 15 turns, so that even when the input gear 631 that meshes with the rack member 62 does not turn together with the needle bar turning base 15 and a turning angle difference is caused between these, the output gear 632 side can be turned by the same turning angle in the same direction as those of the needle bar turning base 15 by the transmission member 64. Therefore, the position of the operating member 16 mounted on the needle bar turning base 15 is not deviated by the turning of the needle bar turning base 15.

[0130] Therefore, even without mounting the solenoid 61 on the needle bar turning base 15, the operating member 16 can be kept at a correct position, so that the needle bars 12 can be correctly held and released.

[0131] Accordingly, the turning weight of the needle bar turning base 15 can be reduced, and without increasing the size of the turning motor 31 that performs a turning operation, a high-speed operation is enabled, so that higher-speed sewing can be realized.

[0132] Also, since there is no need to mount a solenoid on the needle bar turning base 15, a special component such as a slip ring for energizing the solenoid is not necessary, and the sewing machine manufacturing cost can be reduced.

[0133] The double needle sewing machine 1 includes the cloth moving mechanism 80, and forms two seams along a predetermined sewing pattern by controlling the cloth moving mechanism 80 and the turning motors 31 and 463. At this time, the needle bars 12R and 12L also turn according to the sewing advancing direction, and even in this case, the position of the operating member 16 is not deviated by turning of the needle bar turning base 15, so that holding and releasing of the needle bars 12 can be correctly performed by the operating member 16.

[0134] In the needle bar side differential transmission mechanism 63 of the double needle sewing machine 1, the transmission member 64 consists of the small sprocket 642 and the interlocking gear 643 that is a spur gear, and the input gear 631 and the output gear 632 also consist of spur gears, and the rotation axes of these sprocket and gears are all directed in the Z-axis direction, so that in this Z-axis direction, the needle bar side differential transmission mechanism 63 can be easily thinned. Therefore, even in a limited space around the needle bars 12, the needle bar side differential transmission mechanism 63 can be installed.

Modifications

[0135] In the needle bar side differential transmission mechanism 63, the input gear 631 and the transmission member 64 is joined by a timing belt, however, they may be joined by a gear.

[0136] The transmission member 64 consists of the small sprocket 642 and the interlocking gear 643 that is a spur gear, and the rotation axes of these are directed in the Z-axis direction same as the rotation axes of the input gear 631 and the output gear 632, however, they are not limited to this structure.

[0137] For example, in the needle bar side differential transmission mechanism 63, like the shuttle side differential transmission mechanism 40, the input gear 631 and the output gear 632 may be bevel gears that are concentric with each other and opposed to each other, and the transmission member 64 may be a bevel gear that meshes with the input gear 631 and the output gear 632 simultaneously.

[0138] In this structure, the transmission member 64 does not need to include members corresponding to the input gear 631 and the output gear 632, respectively, and power transmission is performed with a single bevel gear, and this is advantageous for reduction in the number of components.

[0139] On the contrary, the first and second bevel gears 442 and 443 and the transmission body 445 of the shuttle side differential transmission mechanism 40 may consist of the same members as the input gear 631, the output gear 632, and the transmission member 64 consisting of the small sprocket 642 and the interlocking gear 643 as in the case of the needle bar side differential transmission mechanism 63.

[0140] In the above-described embodiment, as shown in Fig. 14A, the semicircular annular member 26 fits in the outer peripheral groove 25a of the needle bar holder 25 and transmits the up-down movement of the crank rod 24 to the needle bar holder 25. Instead of this, for example, as shown in Fig. 14B and Fig. 14C, use of an annular member 106 larger than the outer periphery of the needle bar holder 25, support shafts 107 and 107 provided on both end portions of the semicircular annular member 106, first square pieces 261 and 241 provided on the outer sides of the support shafts 107, and second square pieces 108 and 108 provided on the inner sides of the support shafts 107 is easily conceived. In this other embodiment, the second square pieces 108 and 108 support the needle bar holder 25, and even when wear, etc., occurs, the second square pieces 108 can be replaced,

so that maintenance is easy.

[0141] The solenoid 61 may be an air solenoid or an electromagnetic solenoid, or may be another actuator that can be moved and positioned at three positions, such as a stepping motor.

[0142] The configuration of the above-described embodiment is most effectively used in a double needle sewing machine that automatically moves a cloth to be sewn in the X-Y directions, however, it may be applied to a double needle sewing machine which is automatically controlled to be driven and stopped so as to form a predetermined number of stitches, and in which a cloth to be sewn is handled by hands although the cloth is moved with a normal feed dog.

Claims

1. A double needle sewing machine (1) comprising:

two needle bars (12L, 12R) that move up and down along the vertical direction (Z), each of the needle bars (12L, 12R) holding a sewing needle (11);
a needle up-down moving mechanism (80) (20) configured to move the two needle bars (12L, 12R) up and down;
a needle bar turning base (15) supporting the two needle bars (12L, 12R) such that the needle bars (12L, 12R) are movable up and down, the needle bar turning base (15) being supported by a sewing machine frame (101) such that the needle bar turning base (15) is turnable about a center line (C) extending along the vertical direction (Z);
a needle bar turning mechanism (30) including a turning motor (31) as a drive source and configured to turn the two needle bars (12L, 12R) via the needle bar turning base (15); and
a clutch mechanism (50) configured to hold the two needle bars (12L, 12R) and to transmit the up-down movement from the needle up-down moving mechanism (80) (20) to each of the two needle bars (12L, 12R) individually,
characterized in that
the double needle sewing machine (1) further comprises:

an operating member (16) configured to perform a position switching operation on the needle bar turning base (15) to disconnect the transmission to each of the two needle bars (12L, 12R) through the clutch mechanism (50) individually;
an actuator (61) attached to the sewing machine frame (101) in a fixed manner and serving as a drive source for the position switching operation of the operating member (16); and
a differential transmission mechanism (63) configured to receive a drive force from the actuator (61) and to transmit the position switching operation to the operating member (16),

wherein the differential transmission mechanism (63) comprises:

an input member (631) supported on the needle bar turning base (15) such that the input member (631) is turnable about the center line (C) by receiving the drive force from the actuator (61);
an output member (632) supported on the needle bar turning base (15) such that the output member (632) is turnable about the center line (C) to apply the position switching operation to the operating member (16);
a transmission member (64) configured to transmit the turning motion between the input member (631) and the output member (632) such that the turning direction of the turning motion is reversed; and
a turning support (65) supported on the needle bar turning base (15) such that the turning support (65) is turnable about the center line (C), the turning support (65) supporting the transmission member (64) such that the transmission member (64) revolves about the center line (C),
wherein the turning motor (31) is attached to the sewing machine frame (101) in a fixed manner, and
wherein a rotation of the turning motor (31) is transmitted to the needle bar turning base (15) and to the turning support (65) such that the rotation ratio of the needle bar turning base (15) to the turning support (65) is 2:1.

2. The double needle sewing machine (1) according to claim 1, wherein the double needle sewing machine (1) further comprises:

a moving mechanism (80) configured to move a workpiece along a plane orthogonal to the center line (C) and
control means (200) for controlling the moving mechanism (80) and the turning motor (31) to form two seams along a shape of a predetermined sewing pattern.

3. The double needle sewing machine (1) according to claim 1 or 2, wherein the input member (631), the output member (632), and the transmission member (64) are bevel gears.

4. The double needle sewing machine (1) according to claim 1, wherein the differential transmission mechanism (63) further comprise a belt (644) or a gear, and the transmission member (64) is configured to transmit the turning motion between the input member (631) and the output member (632) via the belt (644) or the gear.

5. The double needle sewing machine (1) according to claim 1, wherein the input member (631) comprises an input gear,
the output member (632) comprises an output gear,
the turning support (65) comprises a support plate (651) supported on the needle bar turning base (15) such that the support plate (651) is turnable about the center line (C), and
the transmission member (64) comprises a rotary shaft (641) supported rotatably with respect to the support plate (651), a driven gear (642) fixed and supported on the rotary shaft (641) and coupled to the input gear (631), and an interlocking gear (643) fixed and supported on the rotary shaft (641) and coupled to the output gear (632).

6. The double needle sewing machine (1) according to claim 1, wherein the turning support (65) comprises a sprocket (652) coupled to the turning motor (31) via a timing belt (653), and a support plate (651) provided integrally with the sprocket (652) and supporting the transmission member (64), and
the sprocket (652) is configured such that the rotation ratio of the needle bar turning base (15) to the sprocket (652) is 2:1.

7. The double needle sewing machine (1) according to claim 5, wherein the turning support (65) further comprise a sprocket (652) coupled to the turning motor (31) via a timing belt (653),
the support plate (651) is provided integrally with the sprocket (652), and
the sprocket (652) is configured such that the rotation ratio of the needle bar turning base (15) to the sprocket (652) is 2:1.

8. The double needle sewing machine (1) according to claim 1 or 5, wherein the needle bar turning base (15) comprises a cylindrical upper support portion (15A) and a rectangular intermediate portion (15C),
the differential transmission mechanism (63) is disposed on the upper support portion (15A), and
the operating member (16) and the clutch mechanism (50) is disposed on the intermediate portion (15C).

Patentansprüche

1. Doppelnadelnähmaschine (1), umfassend:

zwei Nadelstangen (12L, 12R), welche sich entlang der vertikalen Richtung (Z) aufwärts und abwärts bewegen, wobei jede der Nadelstangen (12L, 12R) eine Nähnadel (11) hält;
einen Nadel-Auf-Ab-Bewegungsmechanismus (80) (20), welcher dazu ausgebildet ist, die zwei Nadelstangen (12L, 12R) aufwärts und abwärts zu bewegen;
eine Nadelstangendrehbasis (15), welche die zwei Nadelstangen (12L, 12R) hält, derart, dass die Nadelstangen (12L, 12R) aufwärts und abwärts beweglich sind, wobei die Nadelstangendrehbasis (15) von einem Nähmaschinenrahmen (101) gehalten ist, derart, dass die Nadelstangendrehbasis (15) um eine sich entlang der vertikalen Richtung (Z) erstreckende Mittellinie (C) drehbar ist;
einen Nadelstangendrehmechanismus (30), umfassend einen Dreh-Motor (31) als eine Antriebsquelle, welcher dazu ausgebildet ist, die zwei Nadelstangen (12L, 12R) über die Nadelstangendrehbasis (15) zu drehen; und
einen Kupplungsmechanismus (50), welcher dazu ausgebildet ist, die zwei Nadelstangen (12L, 12R) zu halten und die Auf-/Ab-Bewegung von dem Nadel-Auf-Ab-Bewegungsmechanismus (80) (20) auf jede der zwei Nadelstangen (12L, 12R) individuell zu übertragen,
dadurch gekennzeichnet, dass
die Doppelnadelnähmaschine (1) ferner umfasst:

ein Betätigungsglied (16), welches dazu ausgebildet ist, eine Positionsschaltoperation an der Nadelstangendrehbasis (15) durchzuführen, um die Übertragung auf jede der zwei Nadelstangen (12L, 12R) durch den Kupplungsmechanismus (50) individuell zu unterbrechen;
einen Aktuator (61), welcher mit dem Nähmaschinenrahmen (101) fest verbunden ist und als eine Antriebsquelle für die Positionsschaltoperation des Betätigungsglieds (16) dient; und
einen Differentialgetriebemechanismus (63), welcher dazu ausgebildet ist, eine Antriebskraft von dem Aktuator (61) zu empfangen und die Positionsschaltoperation auf das Betätigungsglied (16) zu übertragen,

wobei der Differentialgetriebemechanismus (63) umfasst:

ein Eingangsglied (631), welches an der Nadelstangendrehbasis (15) gehalten ist, derart, dass das Eingangsglied (631) durch Empfang der Antriebskraft von dem Aktua-

tor (61) um die Mittellinie (C) drehbar ist;
ein Ausgangsglied (632), welches an der Nadelstangendrehbasis (15) gehalten ist, derart, dass das Ausgangsglied (632) um die Mittellinie (C) drehbar ist, um das Betätigungsglied (16) mit der Positionsschaltoperation zu beaufschlagen;
ein Übertragungsglied (64), welches dazu ausgebildet ist, die Drehbewegung zwischen dem Eingangsglied (631) und dem Ausgangsglied (632) zu übertragen, derart, dass die Drehrichtung der Drehbewegung umgekehrt wird; und
eine Drehhalterung (65), welche an der Nadelstangendrehbasis (15) gehalten ist, derart, dass die Drehhalterung (65) um die Mittellinie (C) drehbar ist, wobei die Drehhalterung (65) das Übertragungsglied (64) hält, derart, dass das Übertragungsglied (64) um die Mittellinie (C) umläuft,
wobei der Dreh-Motor (31) mit dem Nähmaschinenrahmen (101) fest verbunden ist, und
wobei eine Rotation des Dreh-Motors (31) auf die Nadelstangendrehbasis (15) und auf die Drehhalterung (65) übertragen wird, derart, dass das Rotationsverhältnis der Nadelstangendrehbasis (15) zu der Drehhalterung (65) 2:1 beträgt.

2. Doppelnadelnähmaschine (1) nach Anspruch 1, wobei die Doppelnadelnähmaschine (1) ferner umfasst:

einen Bewegungsmechanismus (80), welcher dazu ausgebildet ist, ein Werkstück entlang einer Ebene orthogonal zu der Mittellinie (C) zu bewegen, und
ein Steuermittel (200) zum Steuern des Bewegungsmechanismus (80) und des Dreh-Motors (31), um zwei Nähte entlang einer Form von einem vorbestimmten Nähmuster zu bilden.

3. Doppelnadelnähmaschine (1) nach Anspruch 1 oder 2, wobei das Eingangsglied (631), das Ausgangsglied (632) und das Übertragungsglied (64) Kegelzahnräder sind.

4. Doppelnadelnähmaschine (1) nach Anspruch 1, wobei der Differentialgetriebemechanismus (63) ferner einen Riemen (644) oder ein Zahnrad umfasst und wobei das Übertragungsglied (64) dazu ausgebildet ist, die Drehbewegung zwischen dem Eingangsglied (631) und dem Ausgangsglied (632) über den Riemen (644) oder das Zahnrad zu übertragen.

5. Doppelnadelnähmaschine (1) nach Anspruch 1, wobei das Eingangsglied (631) ein Eingangszahnrad umfasst,
wobei das Ausgangsglied (632) ein Ausgangszahnrad umfasst,
wobei die Drehhalterung (65) eine Halteplatte (651) umfasst, welche an der Nadelstangendrehbasis (15) gehalten ist, derart, dass die Halteplatte (651) um die Mittellinie (C) drehbar ist, und wobei
das Übertragungsglied (64) eine Drehwelle (641) umfasst, welche bezüglich der Halteplatte (651) drehbar gehalten ist, ein angetriebenes Zahnrad (642), welches an der Drehwelle (641) fixiert und gehalten und an das Eingangszahnrad (631) gekoppelt ist, und ein Verzahnungszahnrad (643), welches an der Drehwelle (641) fixiert und gehalten und an das Ausgangszahnrad (632) gekoppelt ist.

6. Doppelnadelnähmaschine (1) nach Anspruch 1, wobei die Drehhalterung (65) ein Ritzel (652) umfasst, welches über einen Timing-Riemen (653) an den Dreh-Motor (31) gekoppelt ist, und eine Halteplatte (651), welche einstückig mit dem Ritzel (652) bereitgestellt ist und das Übertragungsglied (64) hält, und wobei
das Ritzel (652) derart ausgebildet ist, dass das Rotationsverhältnis der Nadelstangendrehbasis (15) zu dem Ritzel (652) 2:1 beträgt.

7. Doppelnadelnähmaschine (1) nach Anspruch 5, wobei die Drehhalterung (65) ferner ein Ritzel (652) umfasst, welches über einen Timing-Riemen (653) an den Dreh-Motor (31) gekoppelt ist,
wobei die Halteplatte (651) einstückig mit dem Ritzel (652) bereitgestellt ist und wobei
das Ritzel (652) derart ausgebildet ist, dass das Rotationsverhältnis der Nadelstangendrehbasis (15) zu dem Ritzel (652) 2:1 beträgt.

8. Doppelnadelnähmaschine (1) nach Anspruch 1 oder 5, wobei die Nadelstangendrehbasis (15) einen zylindrischen oberen Haltebereich (15A) und einen rechteckigen Zwischenbereich (15C) umfasst,
wobei der Differentialgetriebemechanismus (63) an dem oberen Haltebereich (15A) angeordnet ist und wobei
das Betätigungsglied (16) und der Kupplungsmechanismus (50) an dem Zwischenbereich (15C) angeordnet sind.

Revendications

1. Machine à coudre à double aiguille (1), comprenant :

deux barres à aiguille (12L, 12R) qui se déplacent vers le haut et vers le bas le long de la direction verticale (Z), chacune des barres à aiguille (12L, 12R) retenant une aiguille à coudre (11) ;
un mécanisme de mouvement ascendant-des-

cendant d'aiguille (80) (20) configuré pour déplacer les deux barres à aiguille (12L, 12R) vers le haut et vers le bas ;
une base de rotation de barres à aiguille (15) supportant les deux barres à aiguille (12L, 12R) de sorte que les barres à aiguille (12L, 12R) soient mobiles vers le haut et vers le bas, la base de rotation de barres à aiguille (15) étant supportée par un cadre de machine à coudre (101) de sorte que la base de rotation de barres à aiguille (15) soit rotative autour d'une ligne centrale (C) s'étendant le long de la direction verticale (Z) ;
un mécanisme de rotation de barres à aiguille (30) comportant un moteur rotatif (31) en tant que source d'entraînement et configuré pour faire tourner les deux barres à aiguille (12L, 12R) par l'intermédiaire de la base de rotation de barres à aiguille (15) ; et
un mécanisme à embrayage (50) configuré pour retenir les deux barres à aiguille (12L, 12R) et pour transmettre le mouvement ascendant-descendant du mécanisme de mouvement ascendant-descendant d'aiguille (80) (20) à chacune des deux barres à aiguille (12L, 12R) individuellement,
caractérisée en ce que
la machine à coudre à double aiguille (1) comprend en outre :

un élément d'actionnement (16) configuré pour réaliser une opération de commutation de position sur la base de rotation de barres à aiguille (15) pour disjoindre la transmission à chacune des deux barres à aiguille (12L, 12R) par l'intermédiaire du mécanisme à embrayage (50) individuellement ;
un actionneur (61) fixé au cadre de machine à coudre (101) de manière fixe et servant de source d'entraînement pour l'opération de commutation de position de l'élément d'actionnement (16) ; et
un mécanisme de transmission différentielle (63) configuré pour recevoir une force d'entraînement à partir de l'actionneur (61) et pour transmettre l'opération de commutation de position à l'élément d'actionnement (16),

dans laquelle le mécanisme de transmission différentielle (63) comprend :

un élément d'entrée (631) supporté sur la base de rotation de barres à aiguille (15) de sorte que l'élément d'entrée (631) soit rotatif autour de la ligne centrale (C) en recevant la force d'entraînement de l'actionneur (61) ;
un élément de sortie (632) supporté sur la base de rotation de barres à aiguille (15) de sorte que l'élément de sortie (632) soit rotatif autour de la ligne centrale (C) pour appliquer l'opération de commutation de position à l'élément d'actionnement (16) ;
un élément de transmission (64) configuré pour transmettre le mouvement de rotation entre l'élément d'entrée (631) et l'élément de sortie (632) de sorte que la direction de rotation du mouvement de rotation soit inversée ; et
un support rotatif (65) supporté sur la base de rotation de barres à aiguille (15) de sorte que le support rotatif (65) soit rotatif autour de la ligne centrale (C), le support rotatif (65) supportant l'élément de transmission (64) de sorte que l'élément de transmission (64) tourne autour de la ligne centrale (C),
dans laquelle le moteur rotatif (31) est fixé au cadre de machine à coudre (101) de manière fixe, et
dans laquelle une rotation du moteur rotatif (31) est transmise à la base de rotation de barres à aiguille (15) et au support rotatif (65) de sorte que le rapport de rotation de la base de rotation de barres à aiguille (15) par rapport au support rotatif (65) soit 2:1.

2. Machine à coudre à double aiguille (1) selon la revendication 1, dans laquelle la machine à coudre à double aiguille (1) comprend en outre :

un mécanisme mobile (80) configuré pour déplacer une pièce le long d'un plan orthogonal à la ligne centrale (C) et
un moyen de commande (200) pour commander le mécanisme mobile (80) et le moteur rotatif (31) pour former deux coutures le long d'une forme d'un motif de couture prédéterminé.

3. Machine à coudre à double aiguille (1) selon la revendication 1 ou 2, dans laquelle l'élément d'entrée (631), l'élément de sortie (632), et l'élément de transmission (64) sont des roues d'engrenage coniques.

4. Machine à coudre à double aiguille (1) selon la revendication 1, dans laquelle le mécanisme de transmission différentielle (63) comprend en outre une courroie (644) ou une roue d'engrenage, et l'élément de transmission (64) est configuré pour transmettre le mouvement de rotation entre l'élément d'entrée (631) et l'élément de sortie (632) par l'intermédiaire de la courroie (644) ou la roue d'engrenage.

5. Machine à coudre à double aiguille (1) selon la revendication 1, dans laquelle l'élément d'entrée (631) comprend une roue d'engrenage d'entrée,

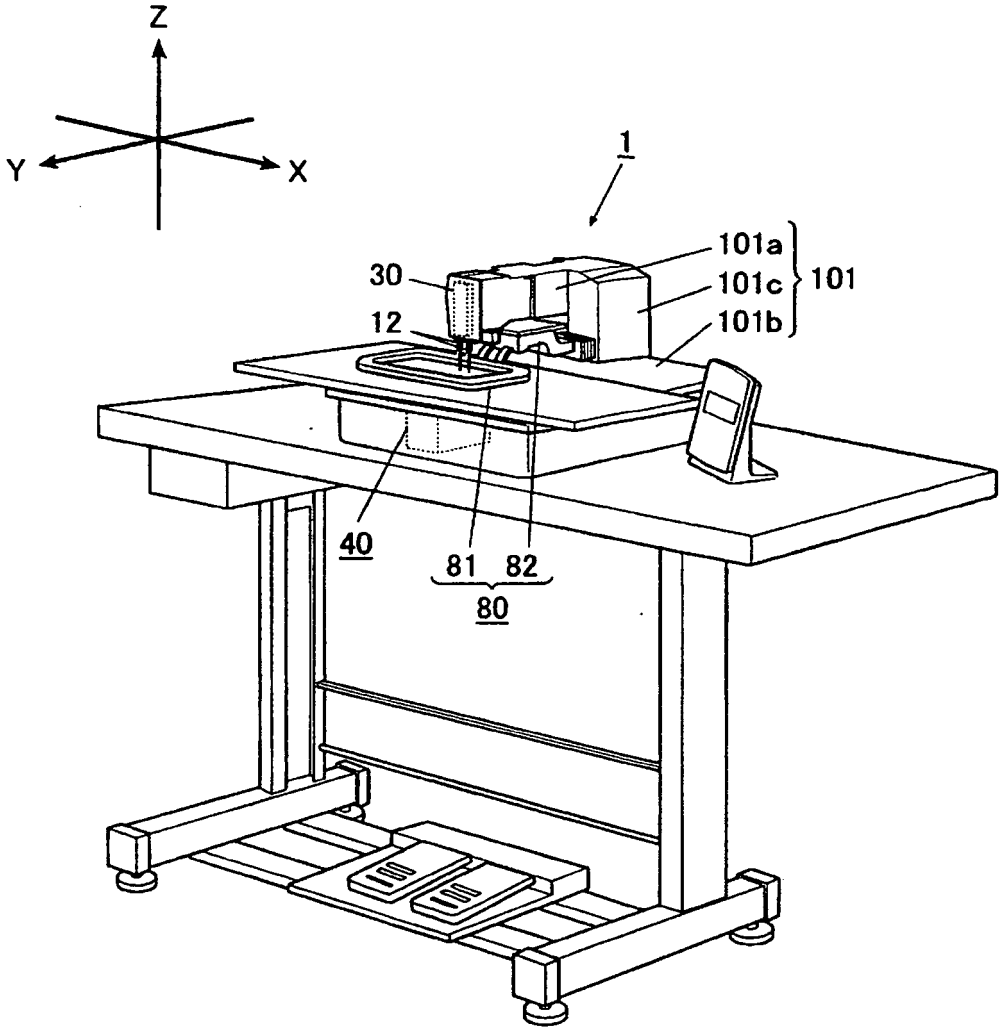
l'élément de sortie (632) comprend une roue d'engrenage de sortie,
le support rotatif (65) comprend une plaque de support (651) supportée sur la base de rotation de barres à aiguille (15) de sorte que la plaque de support (651) soit rotative autour de la ligne centrale (C), et
l'élément de transmission (64) comprend un arbre rotatif (641) supporté de façon rotative par rapport à la plaque de support (651), une roue d'engrenage entraînée (642) fixée et supportée sur l'arbre rotatif (641) et accouplée à la roue d'engrenage d'entrée (631), et une roue d'engrenage d'enclenchement (643) fixée et supportée sur l'arbre rotatif (641) et accouplée à la roue d'engrenage de sortie (632).

6. Machine à coudre à double aiguille (1) selon la revendication 1, dans laquelle le support rotatif (65) comprend un roue dentée (652) accouplée au moteur rotatif (31) par l'intermédiaire d'une courroie synchrone (653), et une plaque de support (651) fournie en une seule pièce avec la roue dentée (652) et supportant l'élément de transmission (64), et
la roue dentée (652) est configurée de sorte que le rapport de rotation de la base de rotation de barres à aiguille (15) par rapport à la roue dentée (652) soit 2:1.

7. Machine à coudre à double aiguille (1) selon la revendication 5, dans laquelle le support rotatif (65) comprend en outre une roue dentée (652) accouplée au moteur rotatif (31) par l'intermédiaire d'une courroie synchrone (653),
la plaque de support (651) est fournie en une seule pièce avec la roue dentée (652), et
la roue dentée (652) est configurée de sorte que le rapport de rotation de la base de rotation de barres à aiguille (15) par rapport à la roue dentée (652) soit 2:1.

8. Machine à coudre à double aiguille (1) selon la revendication 1 ou 5, dans laquelle la base de rotation de barres à aiguille (15) comprend une partie de support supérieure cylindrique (15A) et une partie intermédiaire rectangulaire (15C),
le mécanisme de transmission différentielle (63) est disposé sur la partie de support supérieure (15A), et l'élément d'actionnement (16) et le mécanisme à embrayage (50) sont disposés sur la partie intermédiaire (15C).

FIG. 1



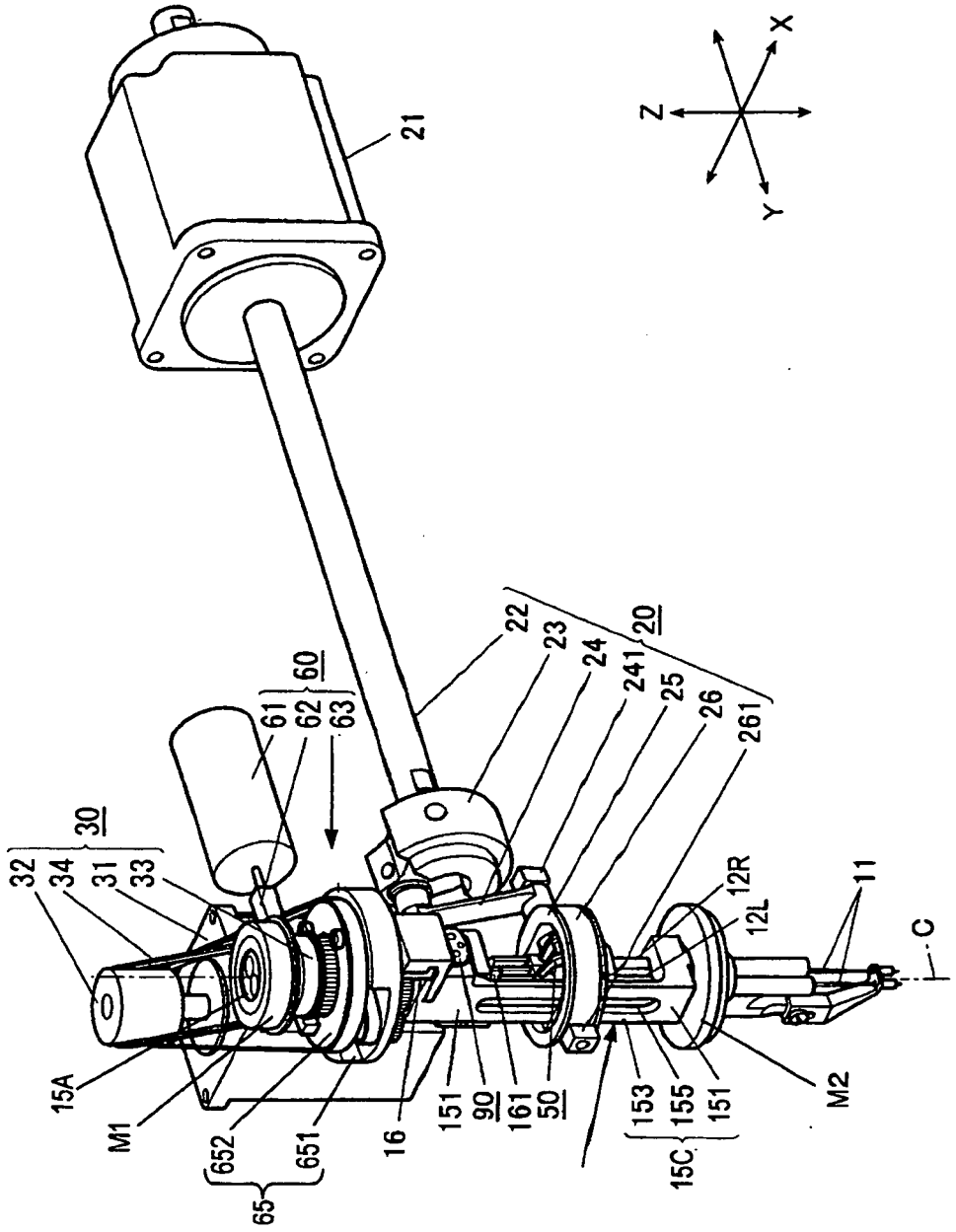

21
X
Z
Y
22
23
24
241
25
26
261
20
60
61
62
63
30
32
34
31
33
12R
12L
11
C
15A
M1
652
651
65
16
151
90
161
50
153
155
151
15C
M2

FIG. 2

FIG. 3

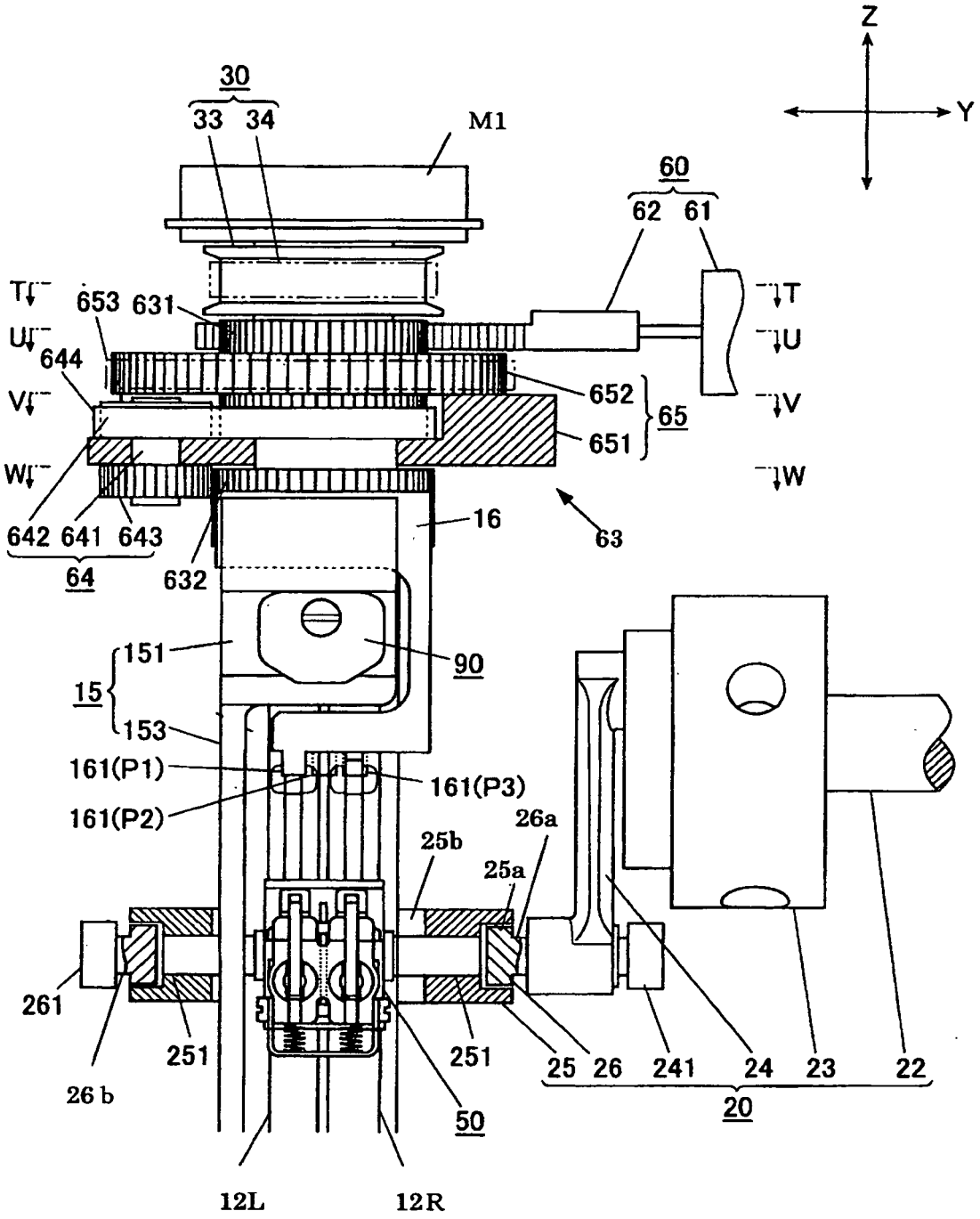

Z
Y
30
33 34
M1
60
62 61
T
653
631
U
644
652
65
651
V
W
642 641 643
64
632
16
63
151
15
153
90
161(P1)
161(P3)
161(P2)
26a
25b
25a
261
251
251
26 b
50
25 26 241 24 23 22
20
12L
12R

FIG. 4

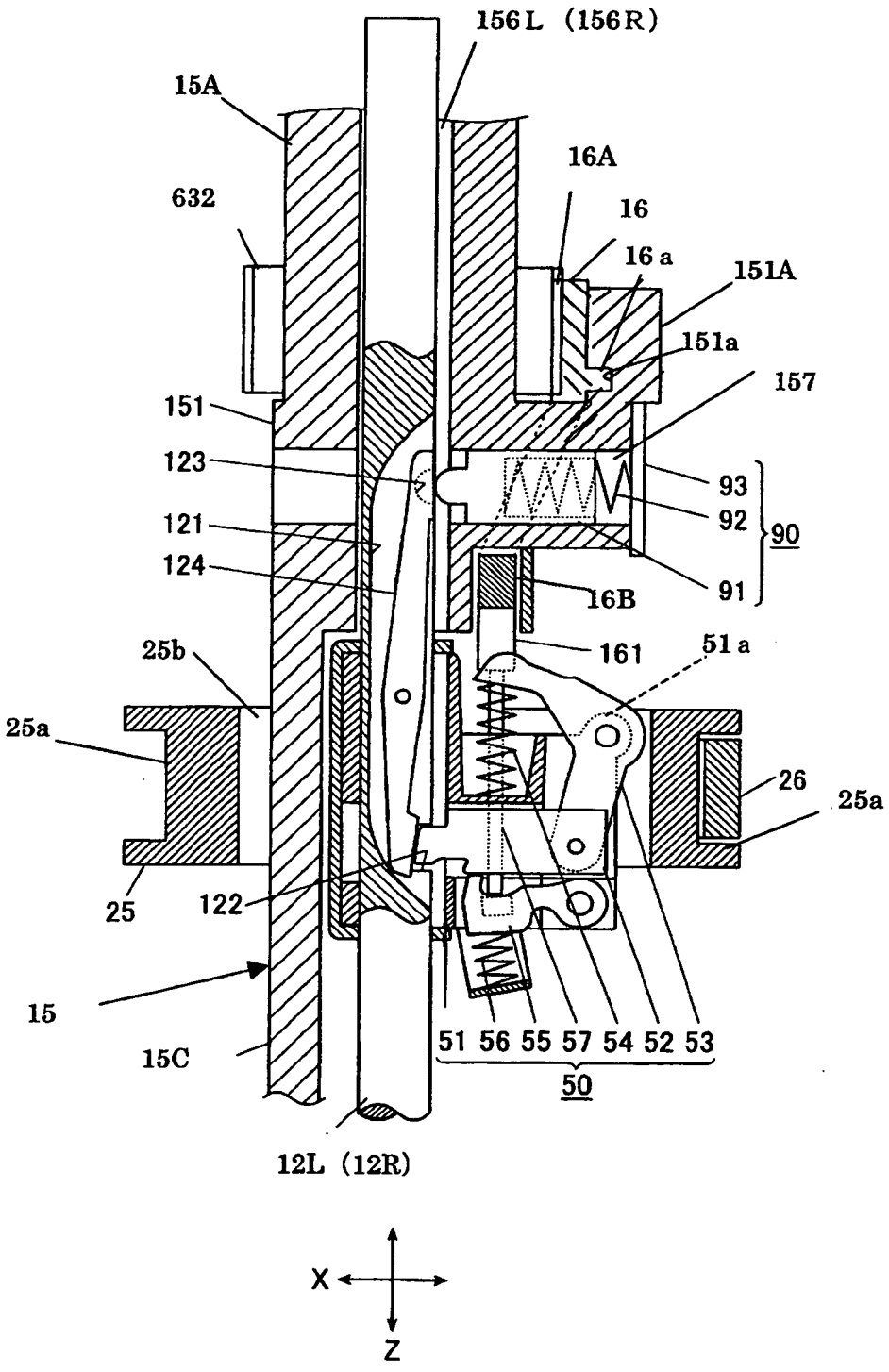

156L (156R)
15A
16A
632
16
16a
151A
151a
157
151
123
93
92
90
121
124
91
16B
161
51a
25b
25a
26
25a
25
122
15
15C
51 56 55 57 54 52 53
50
12L (12R)
X
Z

FIG. 5

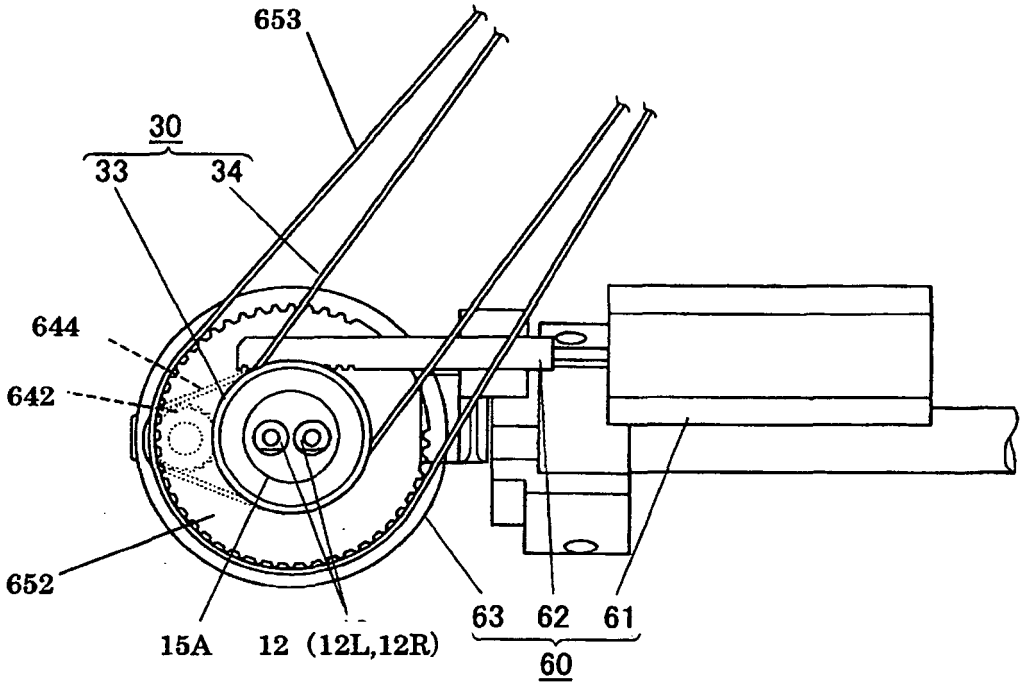


FIG. 6

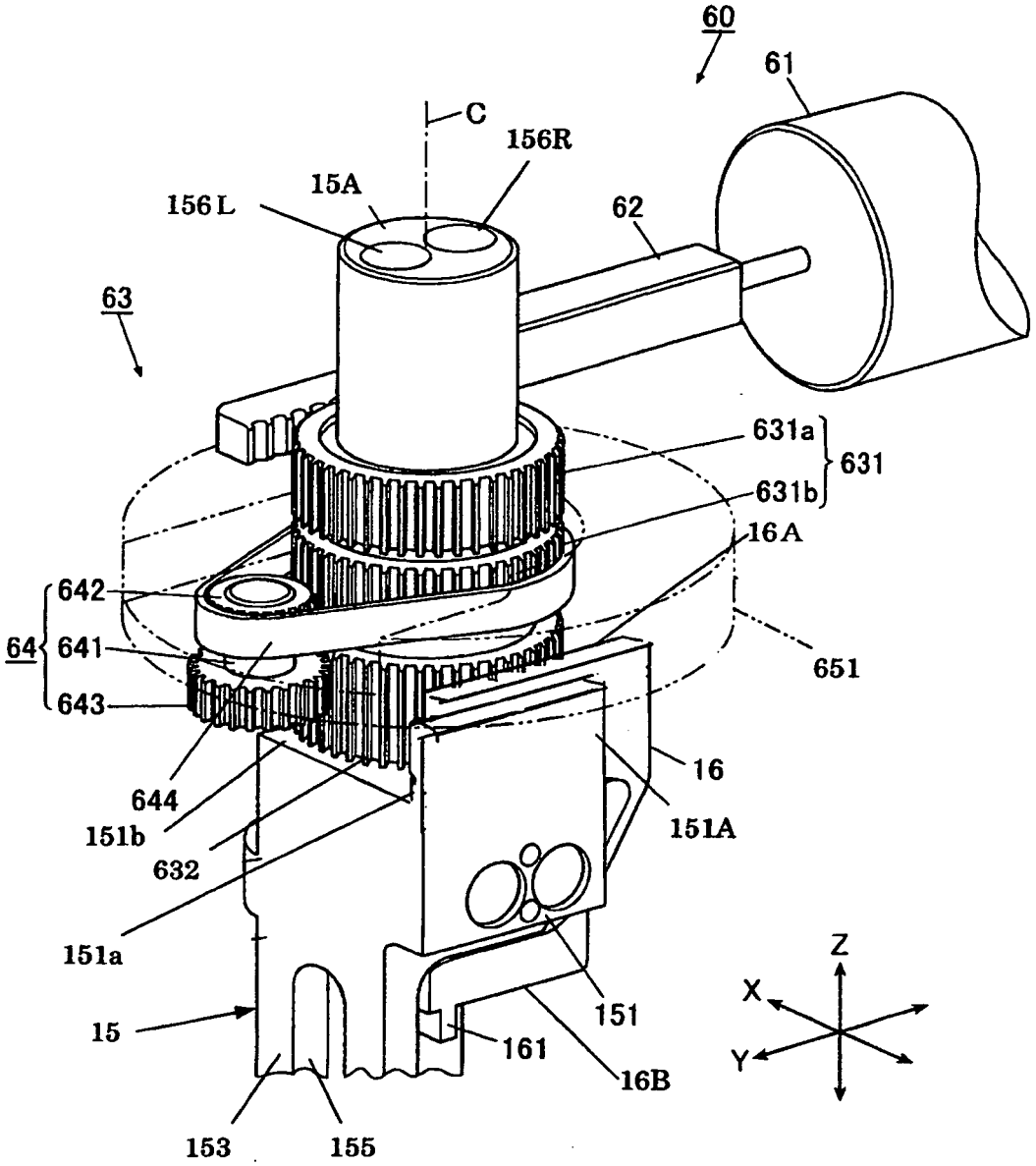

60
61
C
156R
15A
156L
62
63
631a
631
631b
16A
642
64
641
643
651
644
151b
632
16
151A
151a
15
151
161
16B
153
155
Z
X
Y

FIG. 7

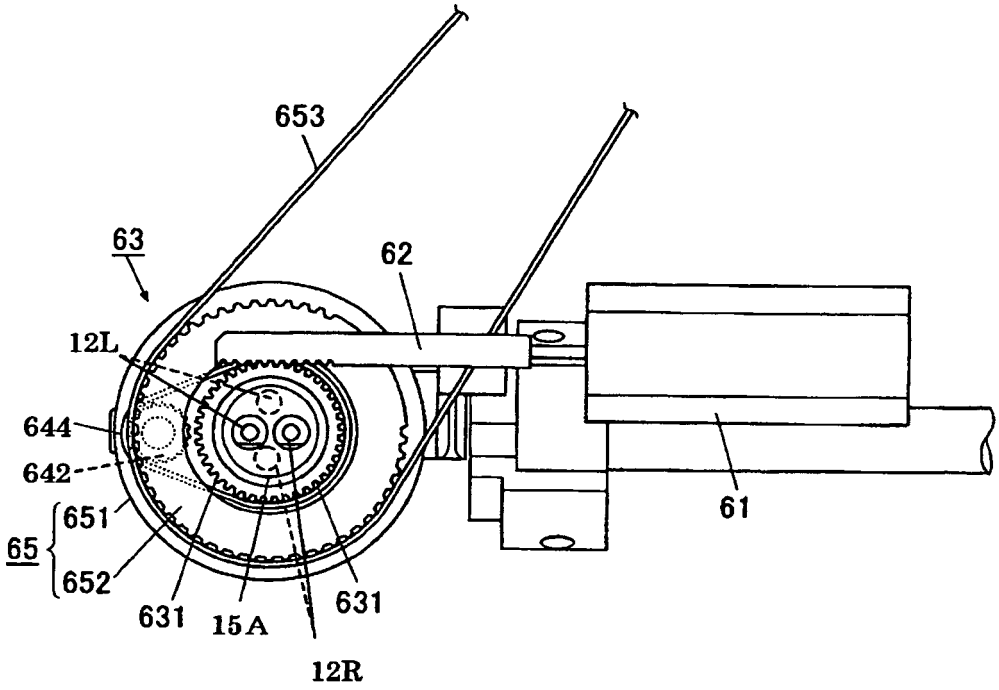


FIG. 8

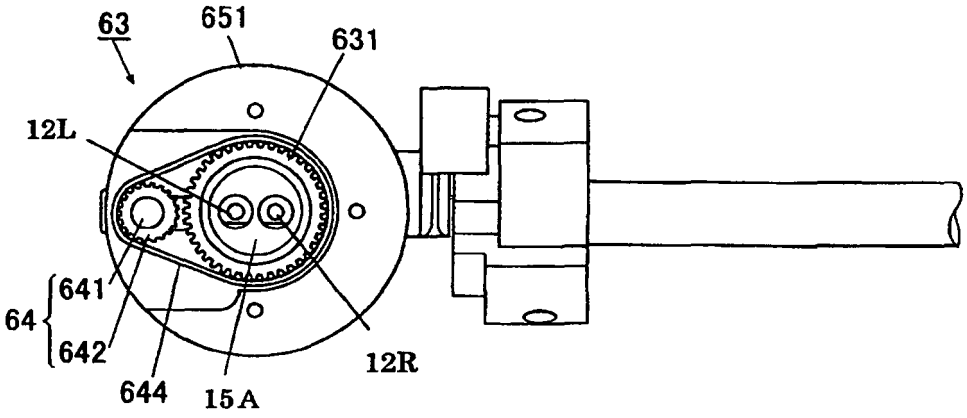


FIG. 9

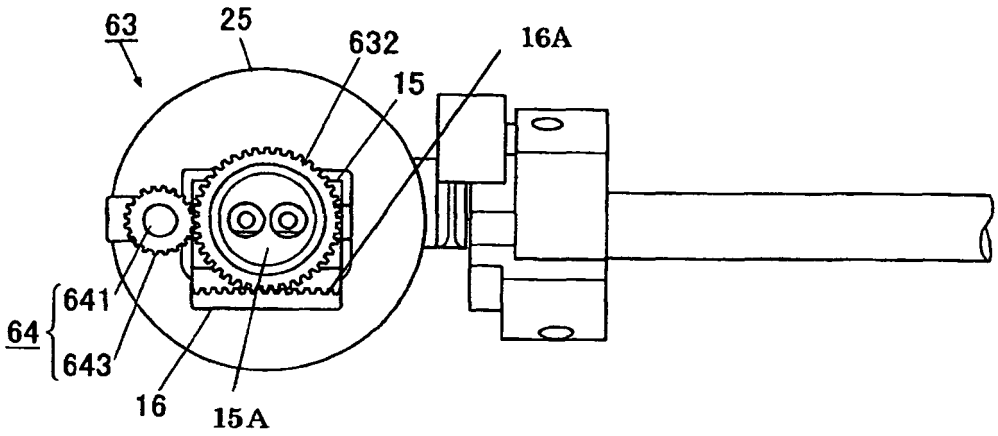


FIG. 10A

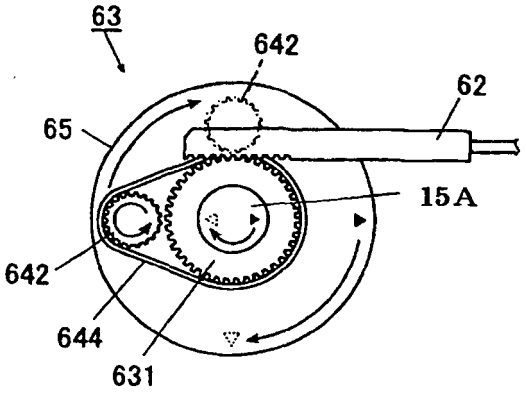


FIG. 10B

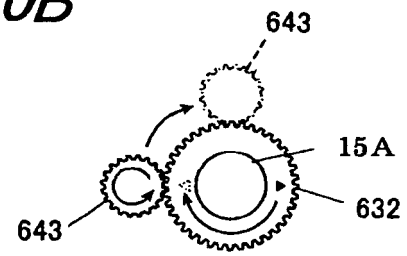


FIG. 10C

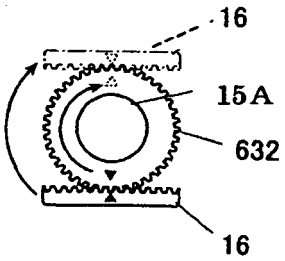


FIG. 11

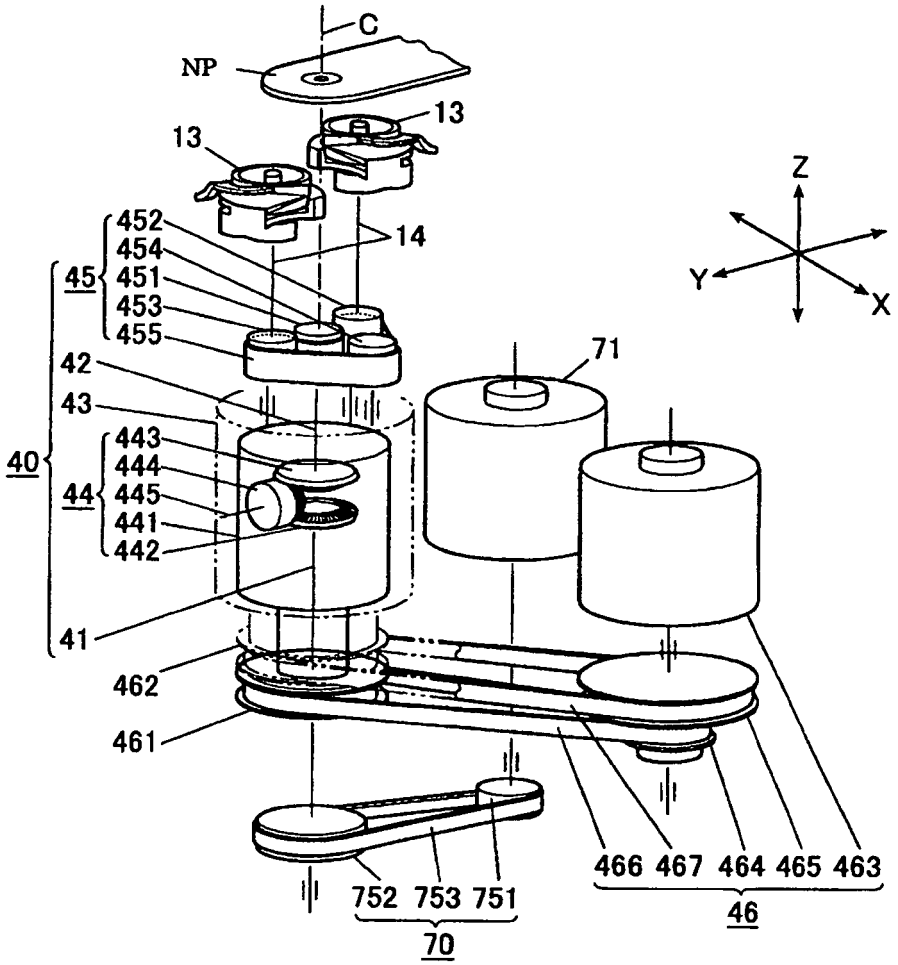

C
NP
13
13
14
452
454
45
451
453
455
42
43
40
443
444
44
445
441
442
41
462
461
71
Z
Y
X
466 467 464 465 463
46
752 753 751
70

FIG. 12

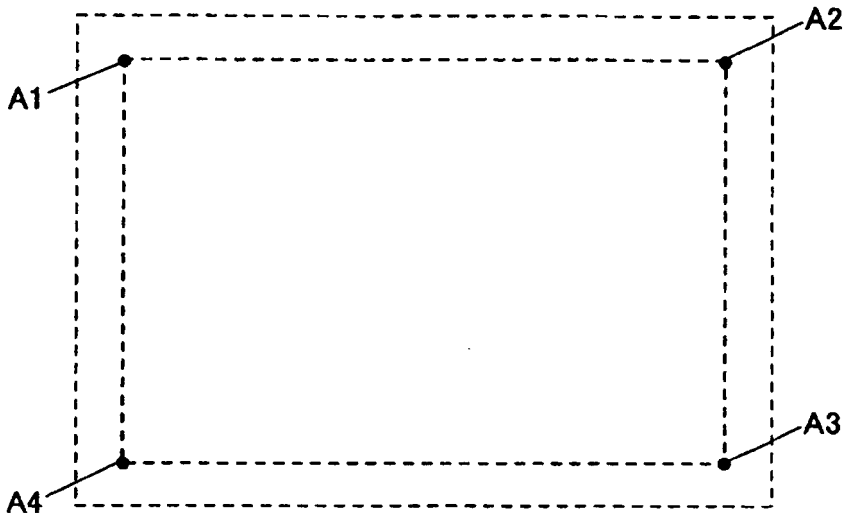


FIG. 13

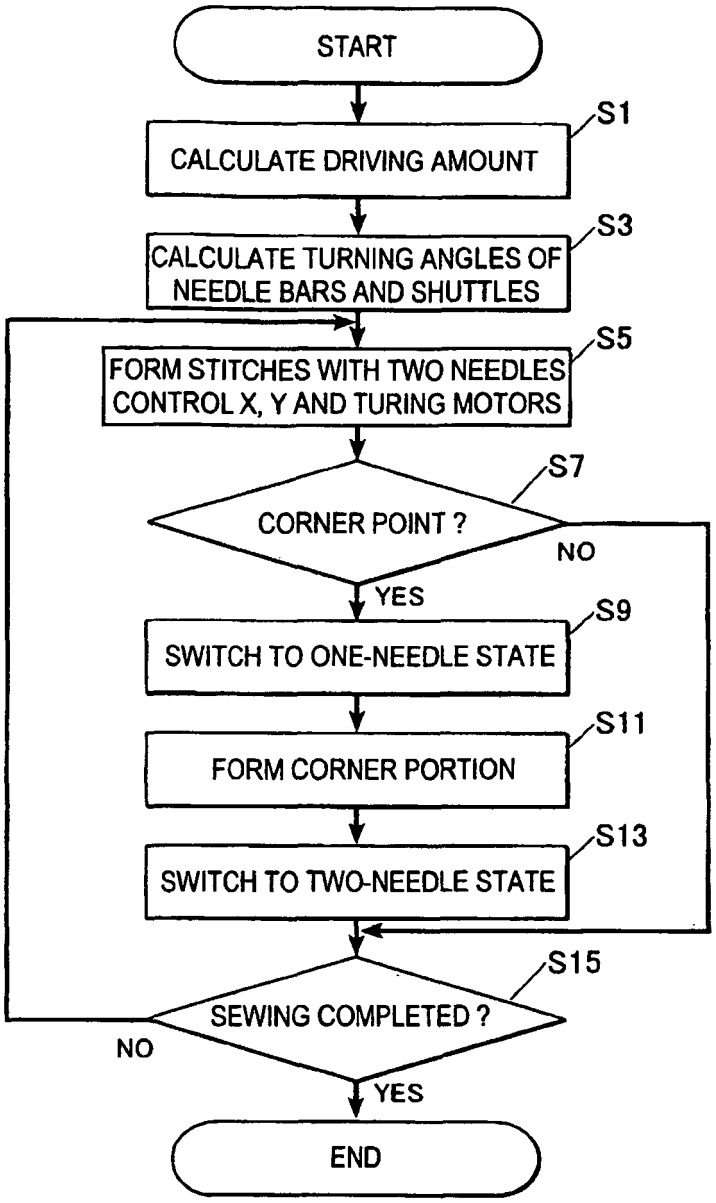

START
S1
CALCULATE DRIVING AMOUNT
S3
CALCULATE TURNING ANGLES OF NEEDLE BARS AND SHUTTLES
S5
FORM STITCHES WITH TWO NEEDLES CONTROL X, Y AND TURING MOTORS
S7
CORNER POINT ?
NO
YES
S9
SWITCH TO ONE-NEEDLE STATE
S11
FORM CORNER PORTION
S13
SWITCH TO TWO-NEEDLE STATE
S15
SEWING COMPLETED ?
NO
YES
END

FIG. 14A

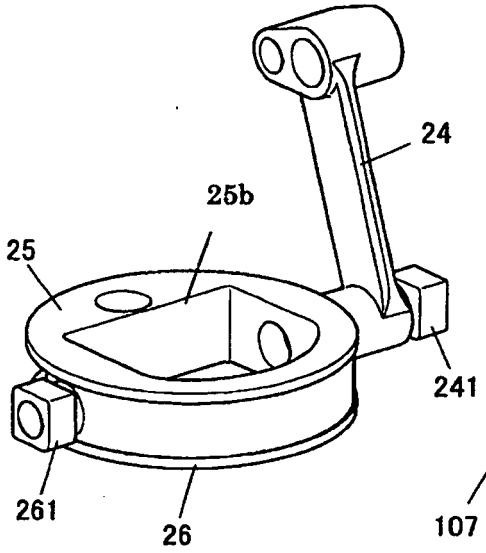


FIG. 14B

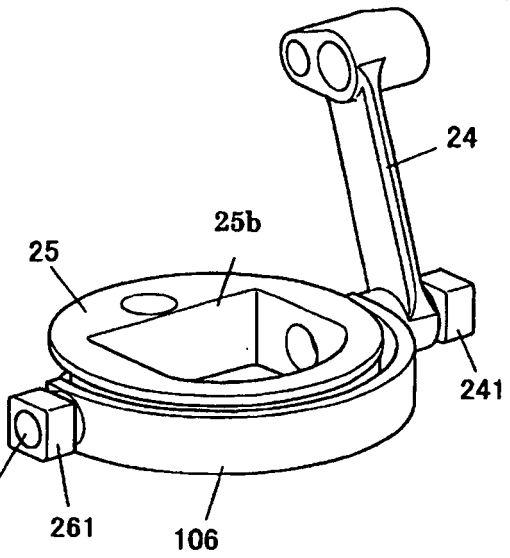


FIG. 14C

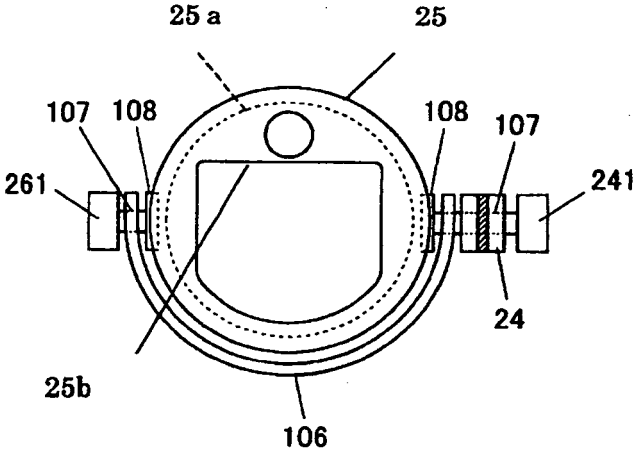


FIG. 15

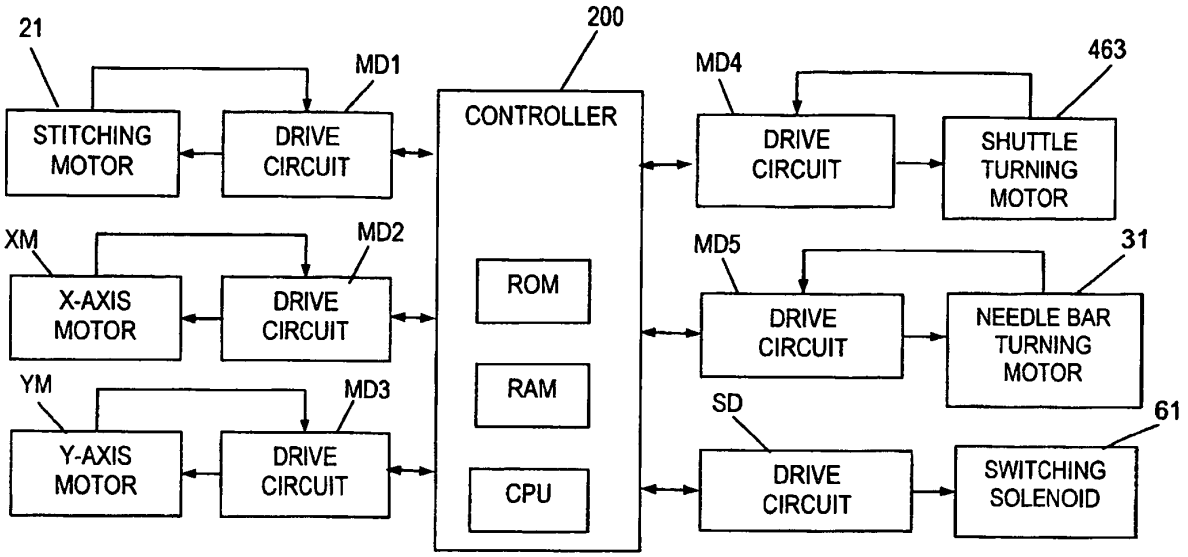

21
MD1
200
MD4
463
STITCHING MOTOR
DRIVE CIRCUIT
CONTROLLER
DRIVE CIRCUIT
SHUTTLE TURNING MOTOR
XM
MD2
MD5
31
X-AXIS MOTOR
DRIVE CIRCUIT
ROM
DRIVE CIRCUIT
NEEDLE BAR TURNING MOTOR
YM
MD3
RAM
SD
61
Y-AXIS MOTOR
DRIVE CIRCUIT
CPU
DRIVE CIRCUIT
SWITCHING SOLENOID

FIG. 16A

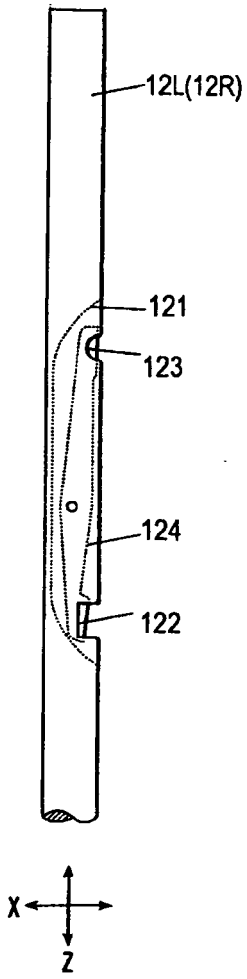
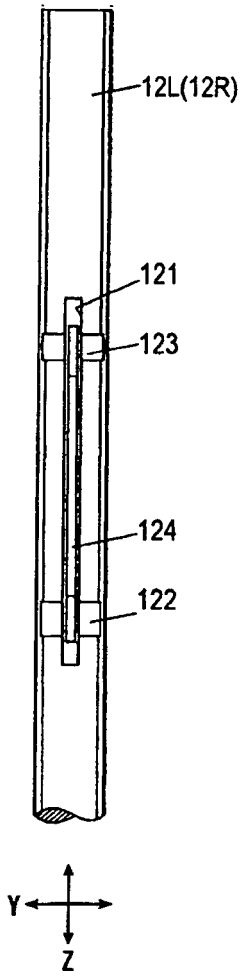


FIG. 16B



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 20080089985 A **[0004]**
- JP 2006141706 A **[0051]**