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(71) Applicant: **Kabushiki Kaisha Toyota Jidoshokki**
Kariya-shi, Aichi-ken (JP)

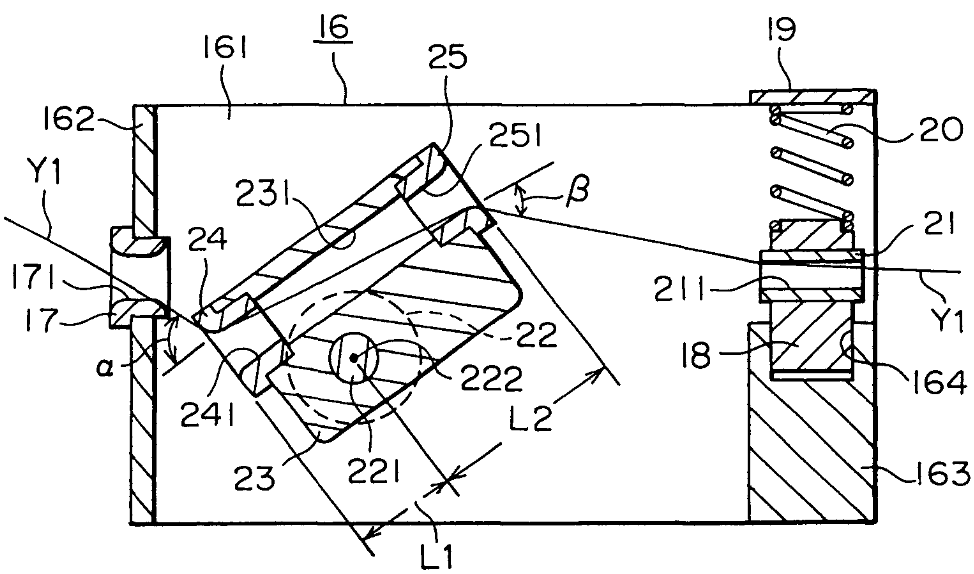
(72) Inventors:
- **Ishikawa, Hirohiko, K.K. Toyota Jidoshokki**
Kariya-shi, Aichi-ken (JP)
- **Shiraki, Masao, K.K. Toyota Jidoshokki**
Kariya-shi, Aichi-ken (JP)

(74) Representative: **HOFFMANN - EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) Weft insertion control apparatus in jet loom

(57) A distance L1 between a rotation axis 222 of a stepping motor 22 and a first guide ring 24 is made shorter than a distance L2 between the rotation axis 222 and a second guide ring 25. When weft Y1 is on a second yarn route, that is, when a yarn route changing body 23 is in a weft braking position, a yarn bending angle α becomes larger than a yarn bending angle β.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a weft insertion control apparatus in a jet loom for inserting weft by a fluid injecting action of a nozzle.

Description of the Related Art

[0002] Running of weft in a jet loom ends when pulling-out of the weft from a storage device of measuring weft length ends. Then, an action for preventing the weft from being pulled out at the end of the pulling-out of the weft suddenly stops the weft, which is running at a high speed, causing a tension of the weft to increase. The sudden increase of the tension may cause breakage of the weft. Thus, a weft insertion control apparatus is used that imparts braking to weft as weft insertion is about to end and controls the sudden increase of a tension.

[0003] Weft insertion control apparatuses of this type are disclosed in Japanese Patent Applications Laid-open Nos. Sho 60-185844, Hei 5-98539, Hei 6-184868 and Hei 7-48760. Of those, a linear member, which is switchingly disposed in a position where it is not brought into contact with weft and a position where it is brought into contact with the weft, is driven by a rotary actuator such as a rotary solenoid and a pulse motor. Braking imparted to the weft as weft insertion is about to end is caused by a bending resistance in the weft that is bent by the linear member disposed in the position where it is brought into contact with the weft.

[0004] In the case of multi-color weft insertion, if weft on standby for insertion sticks out from tips of main nozzles for weft insertion, which are adjacent to each other, it is likely that the weft on standby for insertion is tangled up with weft to be inserted. Thus, it is necessary to pull the weft on standby for insertion into the main nozzles for weft insertion in advance. Japanese Patent Application Laid-open No. Sho 63-135544 discloses a pulling-back device for pulling weft on standby for insertion into a main nozzle for weft insertion in advance.

[0005] It is possible to add a weft pulling-back function to the weft insertion control apparatuses disclosed in Japanese Patent Applications Laid-openNos. Sho 60-185844, Hei 5-98539, Hei 6-184868 and Hei 7-48760. In this case, the rotary actuator is rotated in a direction in which a bending course of the weft is further enlarged. Then, a torque that becomes a load on the rotary actuator further increases. The rotary actuator is required to be enlarged in its size in order to cope with the increase in the load torque, which causes a problem in terms of costs.

[0006] In addition, a tension generated when braking is imparted to weft and a tension generated at the end of pulling-out of weft from the storage device of measuring weft length can be absorbed by the torque of the actuator. However, if increase of the tension at the end of pulling-out of weft, that is, at the end of weft insertion, is absorbed only by the torque of the actuator, the load becomes larger.

SUMMARY OF THE INVENTION

[0007] The present invention has been devised in view of the above and other drawbacks, and it is an object of the present invention to provide a weft insertion control apparatus capable of controlling increase of a tension of weft while controlling a load torque.

[0008] In order to attain the above-mentioned object, the present invention provides a weft insertion control apparatus comprising: yarn route changing means for changing a yarn route of weft between a first yarn route, which becomes a weft route in inserting weft between a storage device of measuring weft length and the nozzle, and a second yarn route for causing a weft insertion resistance larger than a weft insertion resistance in the first yarn route; a first yarn guide disposed on the upstream side of the yarn route changing means; and a second yarn guide disposed on the downstream side of the yarn routechangingmeans, in which the yarn route changing means comprises: first and second contacting bodies that are moved between the first yarn route and the second yarn route while contacting the weft at least on the second yarn route side; and rotary driving means for integrally moving the first and second contacting bodies by a torque, in which a position of a rotation axis of the rotary driving means is set between the pair of contacting bodies, in which a distance between the rotation axis and the first contacting body is made shorter than a distance between the rotation axis and the second contacting body, and in which an arrangement relationship between the pair of yarn guides and the pair of contacting bodies is set so that a yarn bending angle in the first contacting body is larger than a yarn bending angle in the second contacting body when the weft is on the second yarn route.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In the accompanying drawings:

Fig. 1A is a side view showing a weft insertion control apparatus according to a first embodiment of the present invention partially cut away;
Fig. 1B is a sectional view of Fig. 1A taken along a line A-A;
Fig. 2 is a sectional view of Fig. 1A taken along a line B-B;
Fig. 3 is a sectional side view of a main part when a yarn route changing body 23 is in a weft braking position;
Fig. 4 is a sectional side view of a main part when the yarn route changing body 23 is in the weft brak-

ing position;

Fig. 5 is a main part sectional viewwhen the yarn route changing body 23 is in a pulling-back position;

Fig. 6A is a side view showing a weft insertion control apparatus according to a second embodiment of the present invention partially cut away;

Fig. 6B is a sectional view of Fig. 6A taken along a line C-C;

Fig. 7 is a sectional view of Fig. 6A taken along a line D-D;

Fig. 8 is a sectional side view of a main part when a yarn route changing body 23A is in a weft braking position;

Fig. 9 is a sectional side view of a main part when the yarn route changing body 23A is in the weft braking position;

Fig. 10 is a sectional side view of a main part when the yarn route changing body 23A is in a pulling-back position;

Fig. 11A is a side view showing a weft insertion control apparatus according to a third embodiment of the present invention partially cut away;

Fig. 11B is a sectional view of Fig. 11A taken along a line E-E;

Fig. 12 is a sectional view of Fig. 11A taken along a line F-F;

Fig. 13 is a sectional side view of a main part when the yarn route changing body 23 is in the weft braking position;

Fig. 14 is a sectional side view of a main part when the yarn route changing body 23 is in the weft braking position;

Fig. 15 is a sectional side view of a main part when the yarn route changing body 23 is in the pulling-back position;

Fig. 16 is a sectional side view of a main part showing a weft insertion control apparatus according to a fourth embodiment of the present invention;

Fig. 17 is a sectional side view of a main part showing a weft insertion control apparatus according to a fifth embodiment of the present invention;

Fig. 18A is a side view showing a weft insertion control apparatus according to a sixth embodiment of the present invention partially cut away;

Fig. 18B is a sectional view of Fig. 18A taken along a line G-G;

Fig. 19A is a side view showing a weft insertion control apparatus according to a seventh embodiment of the present invention partially cut away; and

Fig. 19B is a sectional view of Fig. 19A taken along a line H-H.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] A first embodiment of the present invention will be hereinafter described based on Figs. 1 to 5.

[0011] As shown in Fig. 1A, weft Y1 is wound and stored on a yarn winding surface 112 by the rotation of a yarn winding tube 111 of a storage device of measuring weft length 11 of a winding system. The weft Y1 wound and stored on the yarn winding surface 112 is pulled out by a fluid injecting action of a main nozzle for weft insertion 13A in a state in which it is released from a locking action of a locking pin 121 driven by an electromagnetic solenoid 12. The locking pin 121 disengages from the yarn winding surface 112 based on an excitation instruction given to the electromagnetic solenoid 12 by a control device 15. The injection of the main nozzle for weft insertion 13A and the disengagement of the locking pin 121 are carried out at different timing or at substantially the same timing depending on a type of yarn.

[0012] A weft unwinding detector 14 of a reflective photoelectrical sensor type is disposed in the vicinity of the yarn winding surface 112. The weft unwinding detector 14 detects wound yarn which is pulled out and unwound from the yarn winding surface 112 and a signal for the detection is sent to the control device 15. When the number of times of unwinding of wound yarn reaches a predetermined number, the control device 15 instructs demagnetization of the electromagnetic solenoid 12 and the locking pin 121 engages with the yarn winding surface 112. When the locking pin 121 engages with the yarn winding surface 112, pulling-out of the weft Y1 is prevented.

[0013] A supporting frame 16 is disposed between the storage device of measuring weft length 11 and the main nozzle for weft insertion 13A. The supporting frame 16 consists of a base plate portion 161 of a flat plate shape, a guide plate portion 162 that is integrally formed with the base plate portion 161 at its end portion on the storage device of measuring weft length 11 side, and a supporting block 163 that is integrally formed with the base plate portion 161 at its end portion on the main nozzle for weft insertion 13A side. A first yarn guide 17 of a ring shape is fastened to the guide plate portion 162. Note that the guide plate portion 162 and the supporting block 163 may have structures in which separate members are attached and fixed to the base plate portion 161, respectively. The first yarn guide 17 is made of ceramics. A supporting hole 164 is recessed at the upper end of the supporting block 163 and a part of a slider 18 is slidably fitted in the supporting hole 164. A second yarn guide 21 of a ring shape is fastened to the slider 18. The second yarn guide 21 is made of ceramics.

[0014] A spring bracket 19 is fastened to the base plate portion 161 so as to oppose the slider 18 and a compression spring 20 is disposed between the spring bracket 19 and the slider 18. The compression spring 20 is energized in a direction for driving the slider 18 into the supporting hole 164. A direction of a threading hole 171 of the first yarn guide 17 and a direction of a threading hole 211 of the second yarn guide 21 are identical. In the state in which the slider 18 is driven into the supporting hole 164 to be brought into contact with its bottom, the threading hole 171 of the first yarn guide 17 and the threading hole 211 of the second yarn guide 21 are disposed on a substantially identical axis when viewed in the direction of the threading hole 171.

[0015] As shown in Figs. 1B and 2, a stepping motor 22 is attached to the back of the base plate portion 161. An output shaft 221 of the stepping motor 22 protrudes through the base plate portion 161 to the front side of the baseplate portion 161. A yarn route changing body 23 is fastened to the protruding portion of the output shaft 221. A yarn passage 231 of a linear shape is provided through the yarn route changing body 23. A first guide ring 24 of a ring shape is fitted in and fixed to one opening of the yarn passage 231. A second guide ring 25 of a ring shape is fitted in and fixed to the other opening of the yarn passage 231. The first guide ring 24 and the second guide ring 25 constitute a contacting body of the yarn route changing means of the present invention. The guide rings 24 and 25 are made of ceramics. Threading holes 241 and 251 of the guide rings 24 and 25 overlap the yarn passage 231 when viewed in the passage direction of the yarn passage 231. The yarn route changing body 23 rotates integrally with the output shaft 221 following the actuation of the stepping motor 22. The weft Y1 is threaded through the first yarn guide 17, the first guide ring 24, the yarn passage 231, the second guide ring 25, and the second yarn guide 21.

[0016] The stepping motor 22 functioning as rotary driving means is subject to the control of the control device 15. The control device 15 controls the actuation of the stepping motor 22 basedon information on detection of a loom rotation angle obtained from a rotary encoder 26 for detecting a rotation angle of a loom. Figs. 1A and 1B show a state immediately before starting to insert the weft Y1. The yarn route changing body 23 is set in a weft inserting position where the passage direction of the yarn passage 231 is the same as the hole direction of the threading holes 171 and 211 immediately before the insertion of the weft Y1 is started. When the passage direction of the yarn passage 231 is in the same direction as the hole direction of the threading holes 171 and 211, the threading hole 171 of the first yarn guide 17 as well as the threading hole 211 and the yarn passage 231 of the second yarn guide 21 are disposed on a substantially identical axis when viewed in the hole direction of the threading hole 211. In this state, the weft Y1 takes a first yarn route which becomes a weft route of a linear shape between the first yarn guide 17 and the second yarn guide 21. Moreover, it is not brought into contact with the guide rings 24 and 25.

[0017] The yarn route changing body 23, the first guide ring 24, the second guide ring 25, and the stepping motor 22 constitute yarn route changing means for changing the yarn route of the weft Y1 between a first yarn route and a second yarn route causing a weft insertion resistance larger than a weft insertion resistance in the first yarn route.

[0018] The second yarn guide 21 provided downstream the pair of guide rings 24 and 25 functioning as contacting bodies is a movable body that is brought into contact with the weft Y1 moving between the first yarn route and the second yarn route. The compression spring 20 is elastically energizing means for elastically energizing the second yarn guide 21 toward the first yarn route side from the second yarn route side. The spring bracket 19 is supporting means for supporting the unmovable end of the compression spring 20. The slider 18, the second yarn guide 21, the spring bracket 19, and the compression spring 20 constitute weft insertion resistance imparting means for imparting a weft insertion resistance, which becomes larger as the weft Y1 moves farther apart from the first yarn route, to the weft Y1 via the second yarn guide 21.

[0019] As shown in Fig. 1A, a main nozzle for weft insertion 13B, which is different from the main nozzle for weft insertion 13A, injects and inserts weft Y2, which is different from the weft Y1. The weft Y2 is measured by a storage device of measuring weft length similar to the storage device of measuring weft length 11. Yarn route changing means having the same structure as the above-mentioned yarn route changing means is disposed between this storage device of measuring weft length and the main nozzle for weft insertion 13B. The weft Y2 is disposed in the first and the second yarn routes described above. An electromagnetic solenoid in the storage device of measuring weft length corresponding to the main nozzle for weft insertion 13B and a stepping motor in the yarn route changing means corresponding to the main nozzle for weft insertion 13B are subject to the control of the control device 15. The main nozzles for weft insertion 13A and 13B select weft based on a weft selecting pattern set in advance and inject the weft.

[0020] Where the weft Y1 is selected and inserted, when the loom rotation angle reaches a predetermined angle, the control device 15 instructs energization of the electromagnetic solenoid 12 and the locking pin 121 disengages from the yarn winding surface 112. In addition, the weft Y1, which is released from the locking action of the locking pin 121 by fluid injection of the main nozzle for weft insertion 13A, is injected from the mainnozzle for weft insertion 13A.

[0021] When the weft insertion of the weft Y1 is about to end, the control device 15 controls the actuation of the stepping motor 22 so that the yarn route changing body 23 is rotated and disposed to a weft braking position of Fig. 3 from the weft insertion position of Fig. 1A. In the state in which the yarn route changing body 23 is in the weft braking position of Fig. 3, the weft Y1 takes the second yarn route, in which the weft Y1 takes a bent shape between the first yarn guide 17 and the second yarn guide 21, while being brought into contact with the pair of yarn guides 17 and 21 and the pair of guide rings 24 and 25. A weft tension at this point moves the second yarn guide 21 and the slider 18 against a spring force of the compression spring 20. A rotating direction of the stepping motor 22 in moving the weft Y1 from the first yarn route to the second yarn route is a direction in which the first guide ring 24 moves from a position on the first yarn route to a side of a position in a rotation axis 222 and the second guide ring 25 moves from a position on the first yarn route to an opposite side of a position in the rotation axis 222.

[0022] When the electromagnetic solenoid 12 is demagnetized and the locking pin 121 engages with the yarn winding surface 112, the pulling-out and unwinding of the weft Y1 is prevented and the weft insertion ends. Increase of the tension at the end of the weft insertion moves the second yarn guide 21 and the slider 18 from the state of Fig. 3 further more against the spring force of the compression spring 20. Fig. 4 shows upward movement of the second yarn guide 21 by the increase of the tension at the end of the weft insertion.

[0023] In the case of multi-color weft insertion, if weft on standby for insertion sticks out from the tips of the main nozzles for weft insertion 13A and 13B, which are adjacent to each other, it is likely that the weft is tangled up with the tip of weft to be inserted. Thus, it is necessary to pull the weft on standby for insertion into the main nozzles for weft insertion in advance. After the inserted weft Y1 is cut and separated from a woven fabric (not shown) , the control device 15 controls the actuation of the stepping motor 22 so that the yarn route changing body 23 is rotated and disposed in a third yarn route that is a pulling-back position of Fig. 5 from the weft braking position of Figs . 3 and 4. A yarn route between the first yarn guide 17 and the second yarn guide 21 in the state of Fig. 5 is brought into a state of bend larger than that in the second yarn route in the state of Fig. 3. Therefore, the weft Y1 extending from the second yarn guide 21 to the main nozzle for weft insertion 13A is pulled back to the storage device of measuring weft length 11 side and the tip of the weft Y1 on standby for insertion is pulled into the main nozzle for weft insertion 13A.

[0024] The first yarn route between the first yarn guide 17 and the second yarn guide 21 takes a liner shape. As shown in Fig. 1B, the first yarn route is perpendicular to the rotation axis 222 when viewed on a plane. As shown in Fig. 1A, an arrangement position of the rotation axis 22 of the stepping motor 22 functioning as rotary driving means is set below the first yarn route and between the pair of yarn guides 17 and 21. A distance L1 between the rotation axis 222 and the first guide ring 24 is set smaller than a distance L2 between the rotation axis 222 and the second guide ring 25. When the yarn route changing body 23 is in the first yarn route, that is, the weft insertion position, a distance L3 between the first yarn guide 17 and the first guide ring 24 is set smaller than a distance L4 between the second yarn guide 21 and the second guide ring 25.

[0025] The following effects are realized in the first embodiment.

(1-1) In the state in which the weft Y1 is inserted along the first yarn route shown in Fig. 1A, the route of the weft Y1 between the first yarn guide 17 and the second yarn guide 21 takes a linear shape with which the weft Y1 is not brought into contact with the pair of guide rings 24 and 25. Therefore, the weft Y1 inserted along the first yarn route is subject to a small weft insertion resistance. The weft Y1 is moved from the first yarn route shown in Fig. 1A to the second yarn route shown in Fig. 3 as the insertion is about to end. A yarn bending angle in a case where weft Y1 is on the first yarn route, is 0°, which is a state in which the weft is not bent. Yarn bending angles α and β in the guide rings 24 and 25 in a case where the weft Y1 is on the second yarn route, are larger than 0°. That is, the yarn bending angles α and β in the guide rings 24 and 25 in the case in which the weft Y1 is on the second yarn route are larger than the yarn bending angles in the guide rings 24 and 25 in the case in which the weft Y1 is on the first yarn route. Therefore, a load applied to the stepping motor 22 when the weft Y1 is moved to the second yarn route as the weft insertion is about to end becomes higher than that in the first yarn route by the change of the yarn route. A bending resistance caused by the bent shape of the second yarn route and the spring force of the compression spring 20 apply a braking action to the weft Y1 in insertion state. Increase of a load in the stepping motor 22 by moving the weft Y1 from the first yarn route to the second yarn route as the weft insertion is about to end decelerates the insertion of the weft Y1, whereby sudden increase of a tension at the end of the insertion of the weft Y1 is controlled.

(1-2) As shown in Fig. 3, when the weft Y1 is on the second yarn route, that is, when the yarn route changing body 23 is in the weft braking position, the yarn bending angle α is larger than the yarn bending angle β. A magnitude relationship between the yarn bending angles α and β is determined by an arrangement relationship between the pair of yarn guides 17 and 21 and the pair of guide rings 24 and 25. In this embodiment, when the yarn route changing body 23 is in the first yarn route that is the weft inserting position, the yarn guides 17 and 21 and the guide rings 24 and 25 are on an identical straight line and relationships of $L1 < L2$ and $L3 < L4$ are set. In addition, the rotating axis 222 is set in a position displaced from the yarn route (in the illustrated example, a position displaced downward). Such an arrangement relationship causes a magnitude relationship $\alpha > \beta$ of the yarn bending angles α and β when the weft Y1 is on the second yarn route. The magnitude relationship $\alpha > \beta$ causes a relationship $F1 > F2$ between a load F1 applied to the first guide ring 24 by the weft tension and a load F2 applied to the second guide ring 25 by the weft tension. The smaller the distance L1 compared with the distance L2 and the smaller the load F2 compared with the load F1, the more a load applied to the stepping motor 22 by the weft tension decreases. Therefore, the magnitude relationship $\alpha > \beta$ concerning the yarn bending angles α and β and the relationship L1 < L2 concerning the distances L1 and L2 are effective in controlling a sudden increase of a tension while controlling the load torque in the stepping motor 22.

(1-3) The larger the yarn bending angle α compared with the yarn bending angle β, the larger the load applied to the first guide ring 24 by the weft tension becomes and the larger a percentage of the control of the sudden increase of a tension to be shared by the first guide ring 24 side becomes. The magnitude relationship $\alpha > \beta$ concerning the yarn bending angles α and β increases the percentage of the control of the sudden increase of a tension to be shared by the first guide ring 24 side. The larger the percentage of the control of the sudden increase of a tension to be shared by the first guide ring 24 side, the easier the control of the load torque in the stepping motor 22 becomes.

(1-4) The distance relationship between the rotating axis 222 and the guide rings 24 and 25 (L1 < L2) is advantageous of gaining aweft pulling-back amount with a fewer rotation amount of the stepping motor 22.

(1-5) When the yarn route changing body 23 moves from the weft inserting position to the weft braking position, that is, when the weft Y1 moves from the first yarn route to the second yarn route, the first guide ring 24 moves from the downstream side to the upstream side of the yarn route. When the weft Y1 moves in this way, the first guide ring 24 moves in the rotating direction of the stepping motor 22. That is, the first guide ring 24 approaches the first yarn guide 17 in the direction of the first yarn route. However, such a relative relationship of movement between the first yarn guide 17 and the first guide ring 24 is advantageous in increasing the yarn bending angle α in the first guide ring 24 with a fewer rotation amount of the stepping motor 22.

(1-6) As shown in Fig. 1A, when the weft Y1 is on the first yarn route, the distance L3 between the first yarn guide 17 and the first guide ring 24 is set smaller than the distance 14 between the second yarn guide 21 and the guide ring 25. As shown in Fig. 3, when the weft Y1 is on the second yarn route, the relationship L3 < L4 remains unchanged. In Fig. 3, the larger the second yarn guide 21 makes the distance L4 in the weft inserting direction from the second guide ring 25, the shorter the yarn bending angle β becomes. In addition, in Fig. 3, the smaller the first yarn guide 17 makes the distance L3 in the weft inserting direction with respect to the first guide ring 24, the larger the yarn bending angle α becomes. Therefore, the relationship L3 < L4 is effective in differentiating the yarn bending angles α and β when the weft Y1 is on the second yarn route.

(1-7) As shown in Fig. 1A, the rotation axis 222 is set in a displaced position lower than the central axis of the yarn passage 231 of the yarn route changing body 23. That is, when the yarn route changing body 23 is rotated such that the weft takes the second yarn route from the first yarn route due to the braking of the weft, the rotation axis 222 is set in a displaced position in the direction perpendicular to the central axis of the yarn passage 231 so that the first guide ring 24 rotates in a direction for approaching the first yarn guide 17. Such setting of the arrangement position of the rotation axis 222 is advantageous in making the yarn bending angel α large with a fewer rotation amount of the stepping motor 22.

(1-8) The compression spring 20 constituting the weft insertion resistance imparting means contracts more at the end of weft insertion than at the time of braking and controls the increase of a tension at the end of the weft insertion. Therefore, the control of increase of a tension at the end of the weft insertion utilizing both the spring force of the compression spring 20 and the bending resistance, is better than the control of the increase of a tension at the end of the weft insertion only by the bending resistance. That is, the weft insertion control utilizing both the spring force of the compression spring 20 and the bending resistance makes the increase of a tension at the end of the weft pulling-out smaller.

(1-9) The elastic force of the compression spring 20 is preferable in controlling sudden increase of a tension at the end of running of the weft.

(1-10) When the pair of guide rings 24 and 25 that are contacting bodies are on a line connecting the pair of yarn guides 17 and 21, the weft Y1. is on the first yarn route. That is, when the weft Y1 is on the first yarn route of a linear shape, the pair of guide rings 24 and 25 are on a line that is parallel with the first yarn route in the state in which they are not brought into contact with the weft Y1. Acceleration of the weft insertion is indispensable for the acceleration of the loom. The non-contacting state of the pair of guide rings 24 and 25 and the weft Y1 eliminates an excessive weft insertion resistance that hinders acceleration of the weft insertion.

(1-11) The state of bend in the second yarn route can be controlled in multiple stages by adjusting a rotating position of the yarn route changing body 23, that is, by adjusting a rotating position of the stepping motor 22. The stepping motor 22 is preferable as rotary driving means in adjusting a braking action with respect to the weft Y1 meticulously.

(1-12) A magnitude of impact due to increase of a tension at the end of the weft insertion differs depending on a type of yarn and a woven width of the weft Y1. This magnitude of impact can be reduced by properly setting the spring force of the compression spring 20 and the bending state of the second yarn route. A configuration for mitigating the impact due to the increase of a tension at the end of the weft insertion caused by both the spring force of the compression spring 20 and the bending state of the second yarn route, enables a more meticulous adjustment compared with a configuration for mitigating impact only by the bending state of the yarn route.

(1-13) An adjustment of a bent route length of the second yarn route, that is, an adjustment of a degree of bending can be performed easily by adjusting the weft braking position of the yarn route changing body 23 . The rotary driving means such as the stepping motor 22 is preferable in adjusting the bent route length of the second yarn route, that is, adjusting the degree of bending.

[0026] Next, a second embodiment of the present invention will be described with reference to Figs. 6 to 10. In the second embodiment, the same components as those in the first embodiment are denoted by the same reference numerals. As shown in Figs. 6B and 7, the output shaft 221 of the stepping motor 22 protrudes through the base plate portion 161 to the front side of the base plate portion 161. A yarn route changing body 23A is fastened to the protruding portion of the output shaft 221. As shown in Fig. 6A, a supporting cylinder 28 is disposed directly above the yarn route changing body 23A. The supporting cylinder 28 is fastened to the base plate portion 161. A part of a movable body 29 is slidably fitted into the supporting cylinder 28. A compression spring 30 is disposed between the movable body 29 and the bottom of the supporting cylinder 28.

[0027] A second yarn guide 27 made of ceramics is fastened to a guide plate portion 165 of the supporting frame 16. The threading hole 171 of the first yarn guide 17 and the threading hole 271 of the second yarn guide 27 coincide with each other when viewed in the hole direction of the threading hole 171. The positional relationship among the rotation axis 222, the yarn guides 17 and 27 and the guide rings 24 and 25 is substantially the same as the relationship among the rotation axis 222, the yarn guides 17 and 21 and the guide rings 24 and 25 in the first embodiment. The yarn Y1 takes the first yarn route at the time of weft insertion, which takes a liner shape between the first yarn guide 17 and the second yarn guide 27. Moreover, it is not brought into contact with the guide rings 24 and 25.

[0028] When the insertion of the weft Y1 is about to end, the control device 15 controls the actuation of the stepping motor 22 so that the yarn route changing body 23A is rotated to be disposed to a yarn braking position of Fig. 8 from a weft inserting position of Fig. 6A. In the state in which the yarn route changing body 23A is in the weft braking position of Fig. 8, the weft Y1 takes the second yarn route, in which the weft Y1 takes a bent shape between the first yarn guide 17 and the second yarn guide 27, while being brought into contact with the pair of yarn guides 17 and 27 and the pair of guide rings 24 and 25. A weft tension at this point moves the movable body 29 against the spring force of the compression spring 20. In the state of Fig. 8, the magnitude relationship of the yarn bending angles α and β in the guide rings 24 and 25 is $\alpha > \beta$.

[0029] When the electromagnetic solenoid 12 is demagnetized and the locking pin 121 engages with the yarn winding surface 112, the pulling-out and disengagement of the weft Y1 is prevented and the weft insertion ends. Increase of a tension at the end of the weft insertion further moves the movable body 29 from the state of Fig. 8 against the spring force of the compression spring 30. Fig. 9 shows upward movement of the movable body 29 due to the increase of a tension at the end of the weft insertion.

[0030] If it is necessary to pull the weft on standby for weft insertion into the main nozzle for weft insertion, after the inserted weft Y1 is cut and separated from a woven fabric (not shown), the control device 15 controls the actuation of the stepping motor 22 so that the yarn route changing body 23A is rotated and disposed of a third yarn route that is a pulling-back position of Fig. 10 from the weft braking position of Figs. 8 and 9. A yarn route between the first yarn guide 17 and the second yarn guide 27 in the state of Fig. 10 is brought into a state of bend larger than that in the second yarn route in the state of Fig. 8. Therefore, the weft Y1 extending from the second yarn guide 27 to the main nozzle for weft insertion 13A is pulled back to the storage device of measuring weft length 11 side and the tip of the weft Y1 on standby for insertion is pulled into the main nozzle for weft insertion 13A.

[0031] The yarn route changing body 23A, the pair of guide rings 24 and 25 and the stepping motor 22 constitute yarn route changing means. The compression spring 30 is elastically energizing means for elastically energizing the movable body 29 toward the first yarn route side from the second yarn route side. The supporting cylinder 28 is a supporting means for supporting unmovable end of the compression spring 30. The movable body 29, the supporting cylinder 28 and the compression spring 30 constitute weft insertion resistance imparting means for imparting a weft insertion resistance, which becomes larger as the weft Y1 moves farther apart from the first yarn route, to the weft Y1 via the movable body 29.

[0032] In the second embodiment, the same effects as those in the first embodiment are realized.

[0033] Next, a third embodiment of the present invention will be described with reference to Figs. 11 to 15. In the third embodiment, the same components as those in the first and the second embodiments are denoted by the same reference numerals.

[0034] A leaf spring 31 is fastened to the upper end of the yarn route changing body 23. The leaf spring 31 extends to the front of the second guide ring 25 along the passage direction of the yarn passage 231. Amovable guide 32 of a ring shape is fastened to the end portion of the leaf spring 31. The movable guide 32 is made of ceramics. When the leaf spring 31 is in its natural state, a threading hole 321 of the movable guide 32 overlaps the yarn passage 231 when viewed in the passage direction of the yarn passage 231. The weft Y1 is threaded through the first yarn guide 17, the guide ring 24 functioning as a first contacting body, the yarn passage 231, the guide ring 25, the movable guide 32 functioning as a second contacting body and the second yarn guide 27.

[0035] The positional relationship among the rotation axis 222, the yarn guides 17 and 27, the guide ring 24 and the movable guide 32 is substantially the same as the relationship among the rotation axis 222, the yarn guides 17 and 21 and the guide rings 24 and 25 in the first embodiment. The yarn Y1 takes the first yarn route at the time of weft insertion, which takes a liner shape between the first yarn guide 17 and the second yarn guide 27. Moreover, it is not brought into contact with the guide rings 24 and 25.

[0036] Figs. 11A and 11B shows a state immediately before starting the weft insertion. Immediately before the insertion of the weft Y1 is started, the yarn route changing body 23 is set in a weft inserting position where the passage direction of the yarn passage 231 is the same as the hole direction of the threading hole 171 of the yarn guide 17. When the yarn route changing body 23 is in the weft inserting position, the threading hole 171 of the first yarn guide 17, the threading hole 271 of the second yarn guide 27, the yarn passage 231 and the threading hole 321 of the movable guide 32 overlap with each other when viewed in the hole direction of the threading holes 171 and 271 of the yarn guides 17 and 27. In this state, the weft Y1 takes a first yarn route that becomes a weft route of a linear shape between the first yarn guide 17 and the second yarn guide 27. Moreover, it is not brought into contact with the guide rings 24 and 25 and the movable guide 32.

[0037] When the insertion of the weft Y1 is about to end, the control device 15 controls the actuation of the stepping motor 22 so that the yarn route changing body 23 is rotated to be disposed of a second yarn route that is a yarn braking position of Fig. 13 from a first yarn route of Fig. 11A. In the state in which the yarn route changing body 23 is in the weft braking position of Fig. 13, the weft Y1 takes a bent shape between the first yarn guide 17 and the second yarn guide 27 while being brought into contact with the yarn guides 17 and 27, the guide rings 24 and 25 and the movable guide 32. The leaf spring 31 at this point is distorted by a weft tension. In the state of Fig. 13, the magnitude relationship of the yarn bending angles α and β in the guide ring 24 and the movable guide 32 is $\alpha > \beta$.

[0038] The yarn route changing body 23, the guide rings 24 and 25, the movable guide 32 and the stepping motor 22 constitute yarn route changing means for changing the yarn route of the weft Y1 between the first yarn route and the second yarn route. The movable guide 32 is a movable body that moves between the first and the second yarn routes and is brought into contact with the weft Y1. The guide ring 24 and the movable guide 32 become movable bodies that are moved between the first and the second yarn routes while being brought into contact with the weft Y1 at least on the second yarn route side. The leaf spring 31 is elastically energizing means for elastically energizing the second yarn guide 27 toward the second yarn route side from the first yarn route side. The yarn route changing body 23 is supporting means for supporting the unmovable end of the leaf spring 31. The yarn route changing body 23, the leaf spring 31 and the movable guide 32 constitute weft insertion resistance imparting means for imparting a weft insertion resistance, which becomes larger as the weft Y1 is further displaced from the first yarn route, to the weft Y1 via the second yarn guide 27.

[0039] Increase of a tension at the end of the weft insertion moves the movable guide 32 downward from the state of Fig. 13 against the spring force of the leaf spring 31. Fig. 14 shows downward movement of the movable guide 32 due to the increase of a tension at the end of the weft insertion. The yarn route changing body 23 is further rotated and, in the third yarn route shown by alternate long and short dash lines of Fig. 15, the weft Y1 is brought into a state of bend larger than that in the second yarn route in the state of Fig. 13. Therefore, the weft Y1 extending from the second yarn guide 27 to the main nozzle for weft insertion 13A is pulled back to the storage device of measuring weft length 11 side and the tip of the weft Y1 on standby for insertion is pulled into the main nozzle for weft insertion 13A.

[0040] The spring force of the leaf spring 31 plays the same role as the compression spring 20 in the first embodiment and the compression spring 30 in the second embodiment. In the third embodiment, the same effects as those in the first embodiment are realized.

[0041] In a fourth embodiment of the present invention shown in Fig. 16, an inserting groove 232 is formed in the yarn route changing body 23 and the leaf spring 31 is inserted and supported in the inserting groove 232. A screw 33 is screwed into the yarn route changing body 23. The tip of the screw 33 is made to abut the base end portion of the leaf spring 31, which is fixed to the yarn route changing body 23 in the inserting groove 232 by tightening the screw 33. The position of the leaf spring 31 in the inserting groove 232 can be adjusted in the state in which the screw 33 is loosened. The length of the part of the leaf spring 31 extending from the tip of the yarn route changing body 23 is adjusted by this adjustment, whereby the spring force of the leaf spring 31 is also adjusted.

[0042] In the fourth embodiment, the adjustment of the spring force of the leaf spring 31 can be performed easily and meticulously and the effect described in the section (1-12) of the first embodiment is further improved.

[0043] In a fifth embodiment of the present invention shown in Fig. 17, a guide pipe 34 made of ceramics is attached to the yarn route changing body 23. The guide pipe 34 functions as both the first contacting body and the second contacting body. The positional relationship among the rotation axis 222, the yarn guides 17 and 27 and the guide pipe 34 is substantially the same as the relationship among the rotation axis 222, the yarn guides 17 and 21 and the guide rings 24 and 25 in the first embodiment. As shown by alternate long and short dash lines in Fig. 17, in the state in which the yarn route changing body 23 is disposed in the second yarn route that is the weft braking position, the magnitude relationship of the yarn bending angles α and β in the guide pipe 34 is $\alpha > \beta$.

[0044] A sixth embodiment of the present invention shown in Figs. 18A and 18B applies the first embodiment to a weft insertion control apparatus with one main nozzle for weft insertion 13. The other components and operations and effects are identical with those in the first embodiment.

[0045] A seventh embodiment of the present invention shown in Figs. 19A and 19B will be described. The same components as those in the second embodiment are denoted by the same reference numerals. A pair of contacting bodies 37 and 38 of a rod shape are vertically provided in a yarn route changing body 36 fastened to the output shaft 221 of the stepping motor 22. The pair of contacting bodies 37 and 38 are dislocated from each other in the vertical direction. In the state of Fig. 19A, weft Y passes through the first yarn route of a linear shape between the yarn guides 17 and 21, and the weft Y and the contacting bodies 37 and 38 are never brought into contact with each other. In the state in which the yarn route changing body 36 is disposed in the braking position indicated by alternate long and short dash lines, the weft Y takes the second yarn route of a bent shape in which the weft Y is brought into contact with the contacting bodies 37 and 38.

[0046] In this embodiment, the same effects as those in the second embodiment are realized.

[0047] In the present invention, the spring force of the compression springs 20 and 30 can be adjusted in the first, the second, the sixth and the seventh embodiments.

[0048] In the present invention, the following embodiments are also possible.

(1) In the first to the seventh embodiments, a yarn introducing port of the main nozzle for weft insertion is used as the second yarn guide.
(2) An air spring or a magnetic force is used as the weft insertion resistance imparting action of the weft insertion resistance imparting means.
(3) A servomotor is used as the rotary driving means.

Claims

1. A weft insertion control apparatus in a jet loom for inserting weft by a fluid injecting action of a nozzle, comprising:

    yarn route changing means for changing a yarn route of weft between a first yarn route, which becomes a weft route in inserting weft between a storage device of measuring weft length and said nozzle, and a second yarn route for causing a weft insertion resistance larger than a weft insertion resistance in said first yarn route;
    a first yarn guide disposed on the upstream side of said yarn route changing means; and
    a second yarn guide disposed on the downstream side of said yarn route changing means,

    wherein said yarn route changing means comprises: first and second contacting bodies that are moved between said first yarn route and said second yarn route while contacting said weft at least on said second yarn route side; and rotary driving means for integrally moving said first and second contacting bodies by a torque,
    wherein a position of a rotation axis of said rotary driving means is set between said pair of contacting bodies,
    wherein a distance between said rotation axis and said first contacting body is made smaller than a distance between said rotation axis and said second contacting body, and
    wherein an arrangement relationship between said pair of yarn guides and said pair of contacting bodies is set so that a yarn bending angle in said first contacting body is larger than a yarn bending angle in said second contacting body when said weft is on said second yarn route.

2. A weft insertion control apparatus in a jet loom according to claim 1,
    wherein said first contacting body is disposed on the upstream side of said second contacting body, said first yarn route between said pair of yarn guides is a linear route, and said first contacting bodymoves from the downstream side to the upstream side and approaches said first yarn guide in a rotating direction of said rotary driving means when said weft moves from said first yarn route to said second yarn route.

3. A weft insertion control apparatus in a jet loom according to claim 2,
    wherein a distance between said first yarn guide and said first contacting body is made smaller than a distance between said second yarn guide and said second contacting body.

4. A weft insertion control apparatus in a jet loom according to claim 3,

wherein said rotation axis is set in a position displaced from said first yarn route, and a rotating direction of said rotary driving means in moving said weft from said first yarn route to said second yarn route is a direction in which said first contacting body moves from a position in said first yarn route to a side of a position in said rotation axis and said second contacting body moves from a position in said first yarn route to an opposite side of a position in said rotation axis.

5. A weft insertion control apparatus in a jet loom according to claim 4,

wherein said yarn route changing means changes a yarn route of weft among a first yarn route that becomes a weft route at said weft insertion time, a second yarn route that bends weft to cause a weft insertion resistance larger than a weft insertion resistance in said first yarn route, and a third yarn route that bends weft more largely than that on said second yarn route to pull back said weft.

6. A weft insertion control apparatus in a jet loom according to any one of claims 1 to 5,

wherein said pair of contacting bodies are guide rings through which said weft is threaded and said pair of guide rings are in a position where said pair of guide rings do not contact said weft on said first yarn route when said weft is on said first yarn route.

7. A weft insertion control apparatus in a jet loom for inserting weft by a fluid injecting action of a nozzle, comprising:

yarn route changing means for changing a yarn route of weft between a first yarn route and a second yarn route for causing a weft insertion resistance larger than a weft insertion resistance in said first yarn route; and
weft insertion resistance imparting means that has a movable body to be brought into contact with weft moving between said first yarn route and said second yarn route by said yarn route changing means and imparts a weft insertion resistance, which becomes larger as said weft moves further apart from said first yarn route, to said weft via said movable body,

wherein said yarn route changing means comprises: a contacting body that is moved between said first yarn route and said second yarn route while contacting said weft at least on said second yarn route side; and rotary driving means for moving said first and second contacting bodies by a torque, and

wherein said movable body is made movable only by a weft tension when said movable body is brought into contact with said weft moving between said first yarn route and said second yarn route.

8. A weft insertion control apparatus in a jet loom according to claim 7,

wherein said weft insertion resistance imparting means comprises: a yarn guide as said movable body for threading said weft through the yarn guide while causing said weft to be brought into contact with the yarn guide at least on said second yarn route side; elastically energizing means for elastically energizing said yarn guide toward from said second yarn route side to said first yarn route side to impart a weft insertion resistance to said weft; and supporting means for supporting an unmovable end of said elastically energizing means, said supporting means being unmovably disposed.

9. A weft insertion control apparatus in a jet loom according to claim 8,

wherein said yarn guide constituting said weft insertion resistance imparting means is disposed on the downstream side of said contacting body.

10. Aweft insertion control apparatus in a jet loom according to claim 7,

wherein said weft insertion resistance imparting means comprises: a movable body that is brought into contact with said weft at least on said second yarn route side; elastically energizing means for elastically energizing said movable body from said second yarn route side toward said first yarn route side; and supporting means for supporting an unmovable end of said elastically energizing means, said supporting means being unmovably disposed.

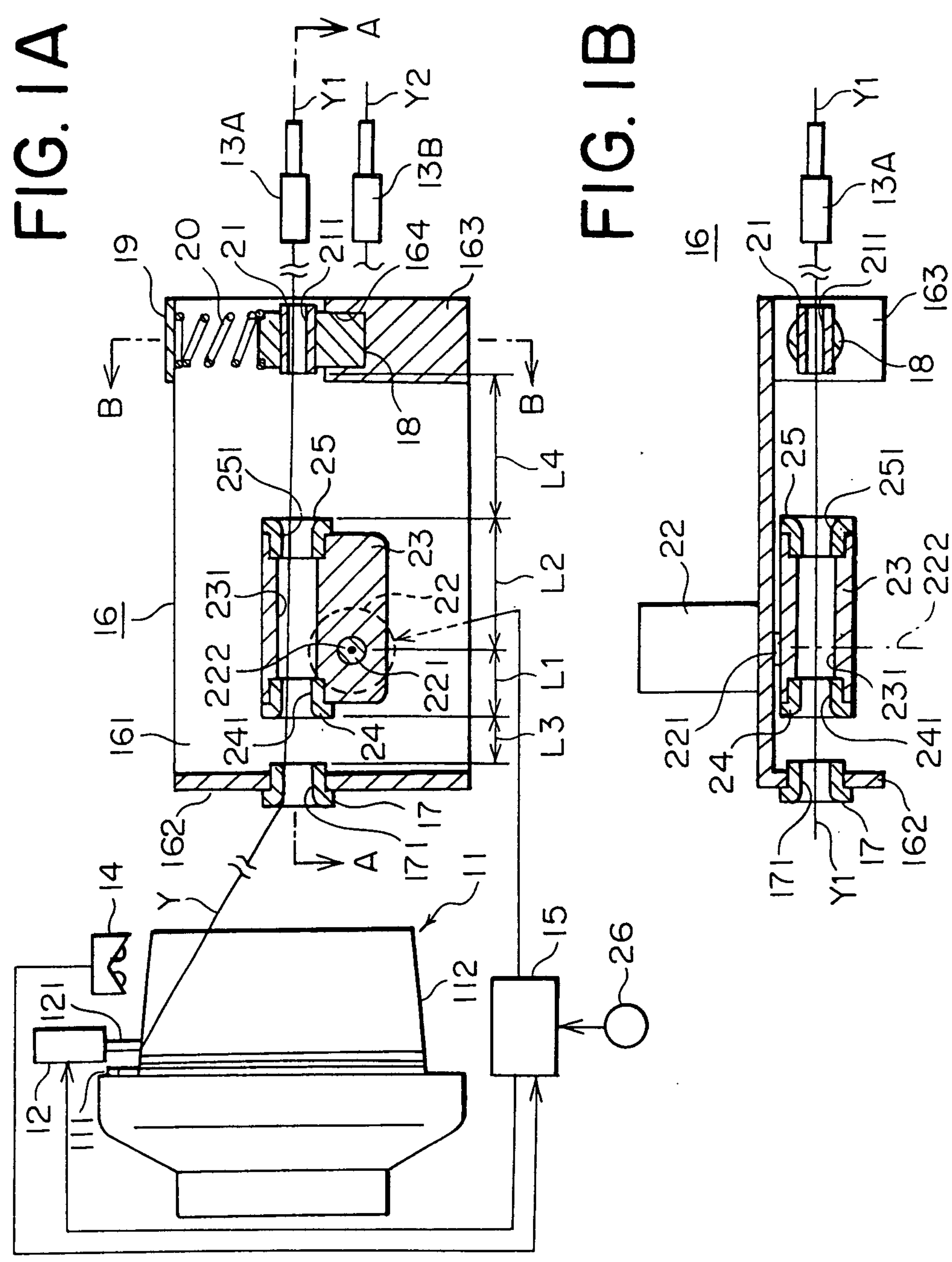
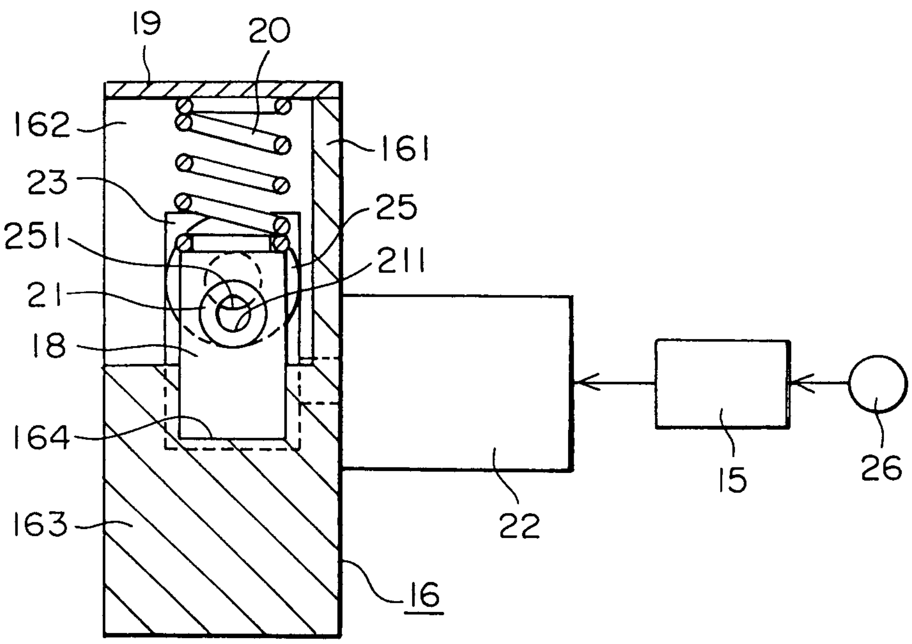


FIG. 1A
FIG. 1B
Y1
Y2
13A
13B
16
19
20
21
211
164
163
18
25
251
23
231
22
222
221
24
241
161
162
17
171
L1
L2
L3
L4
A
B
Y
11
111
112
12
121
14
15
26

FIG. 2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23
25
251
211
21
18
164
163
16
22
15
26

FIG. 3

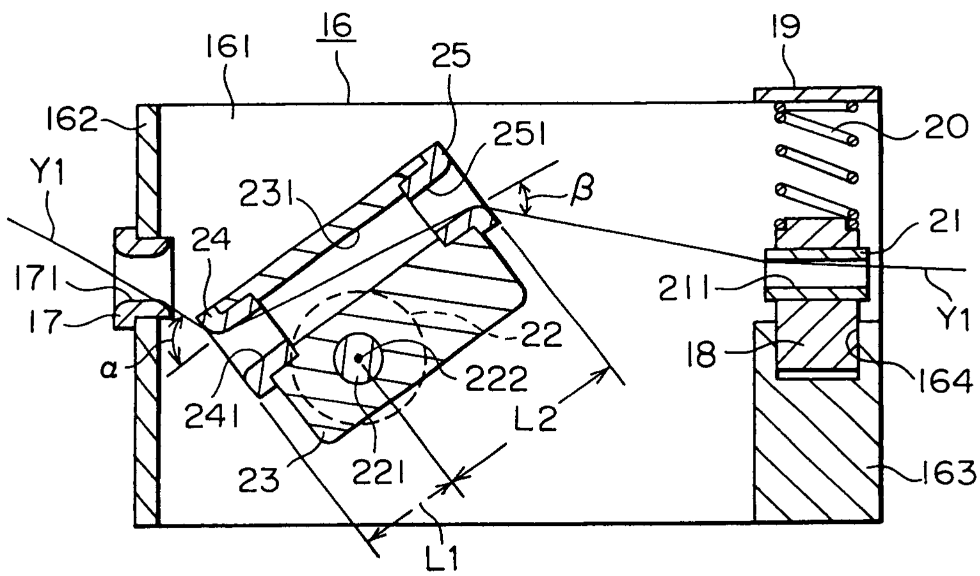
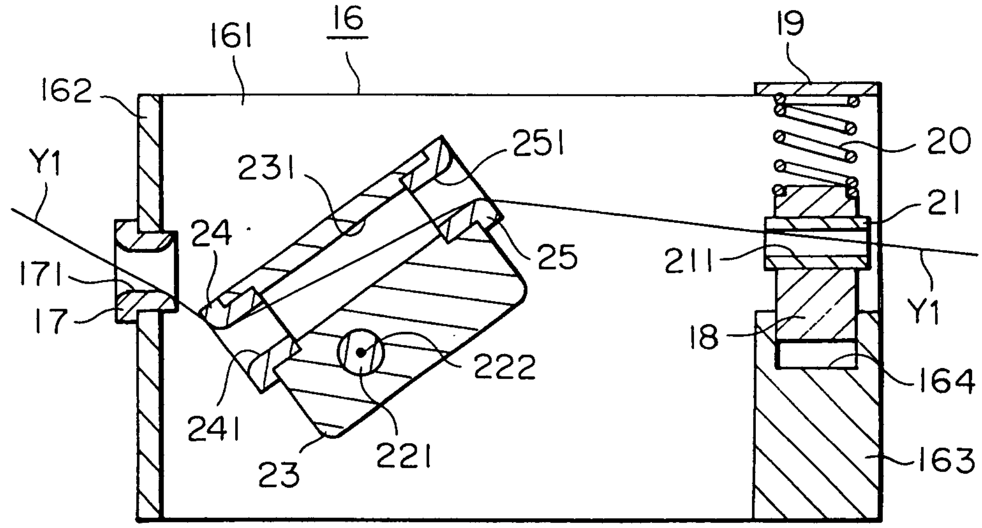

16
161
25
19
162
251
20
Y1
231
β
24
21
171
211
17
22
Y1
α
18
222
164
241
L2
23
221
163
L1

FIG. 4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16
19
162
20
Y1
231
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211
171
Y1
17
18
222
164
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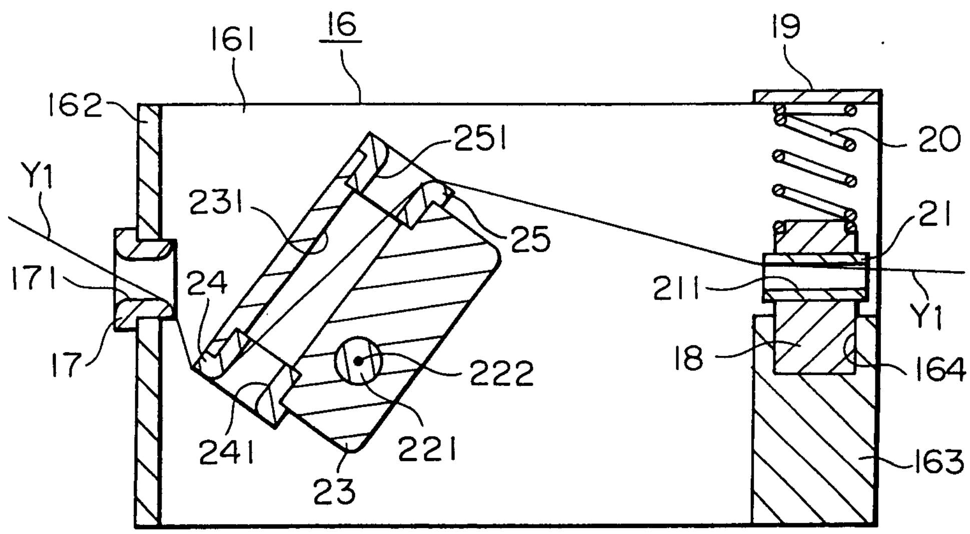
221
163
23

FIG. 5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16
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Y1
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Y1
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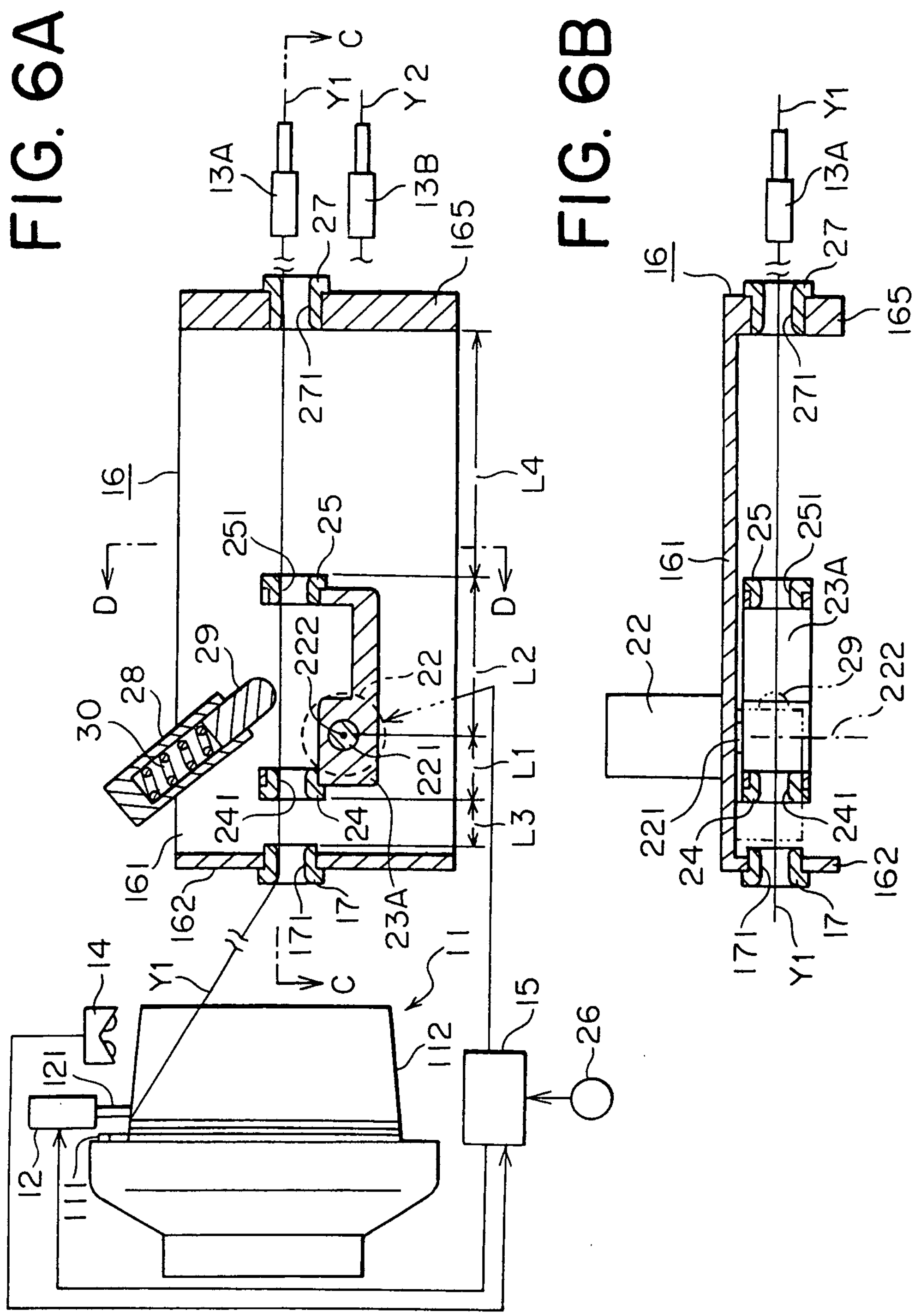
23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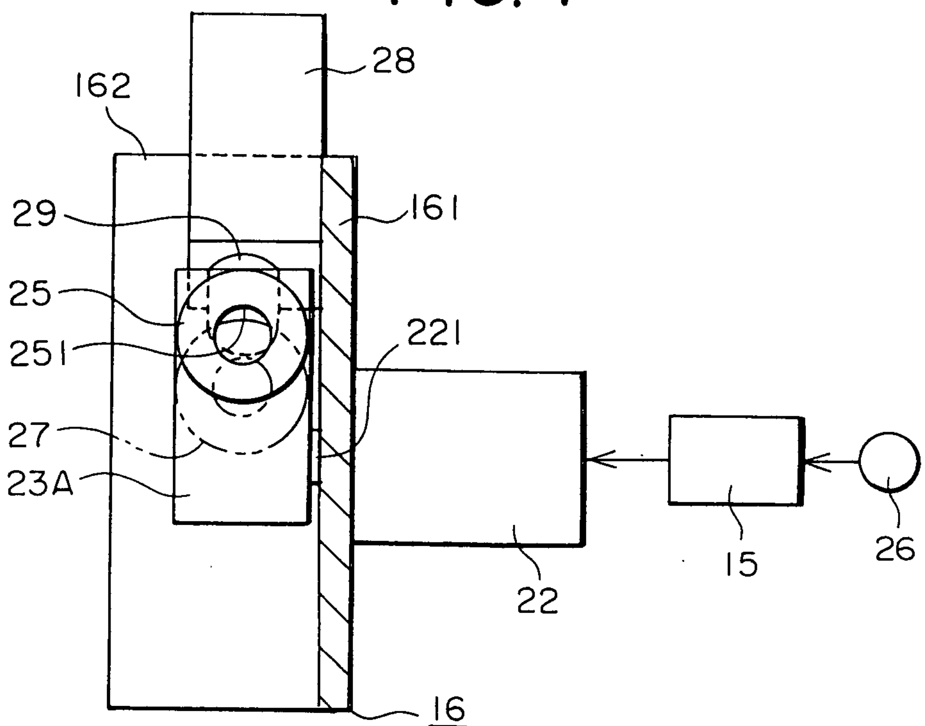
161
162
165
17
171
22
221
222
23A
24
241
25
251
26
27
271
28
29
30
11
111
112
12
121
13A
13B
14
15
Y1
Y2
C
D
L1
L2
L3
L4

FIG. 6A

FIG. 6B

FIG. 7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29
161
25
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27
23A
15
26
22
16

FIG. 8

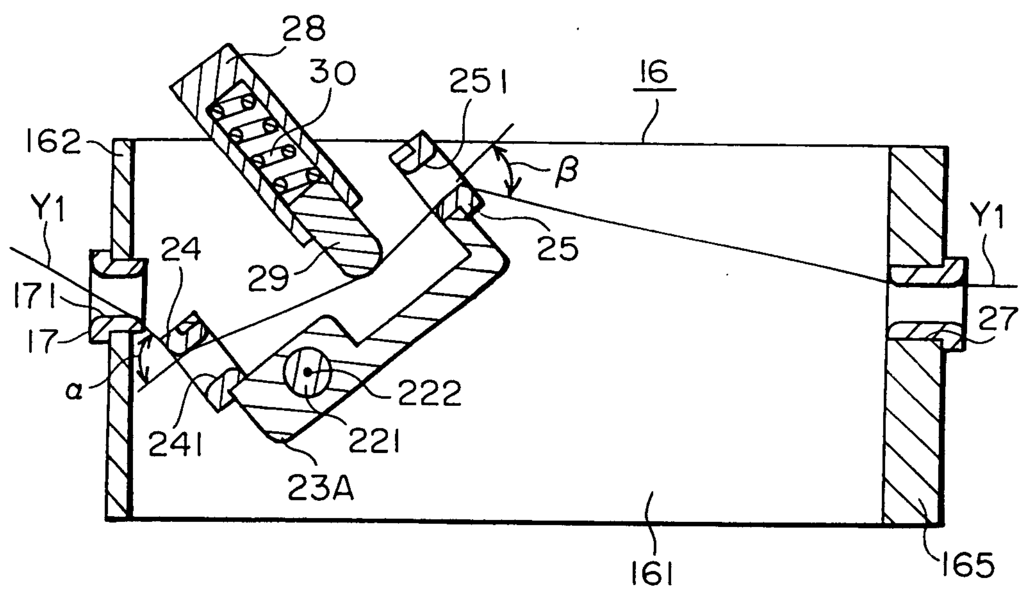
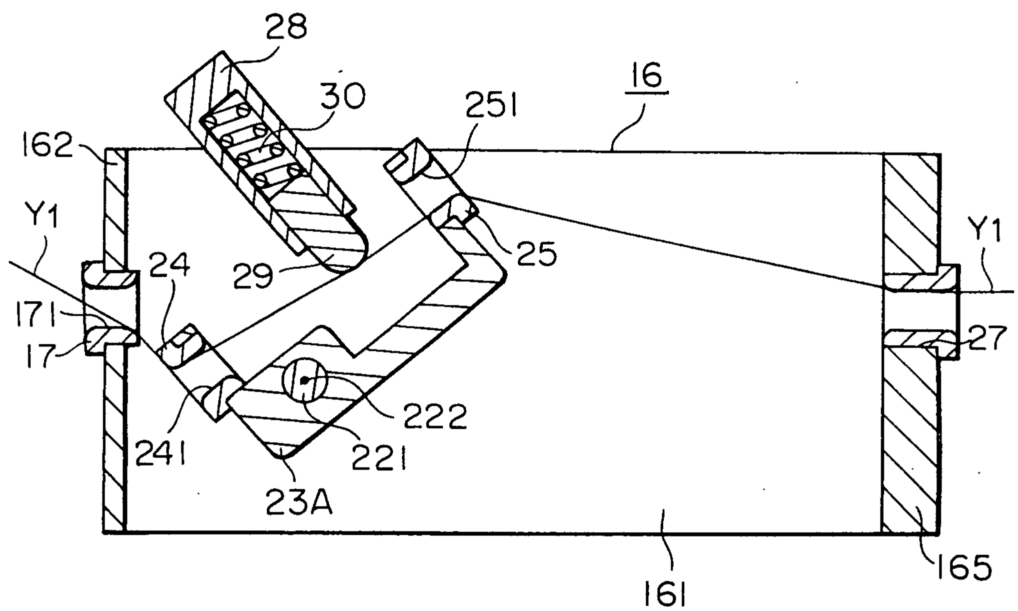

28
30
251
16
162
β
25
Y1
24
Y1
171
29
27
17
α
222
241
221
23A
161
165

FIG. 9


28
30
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251
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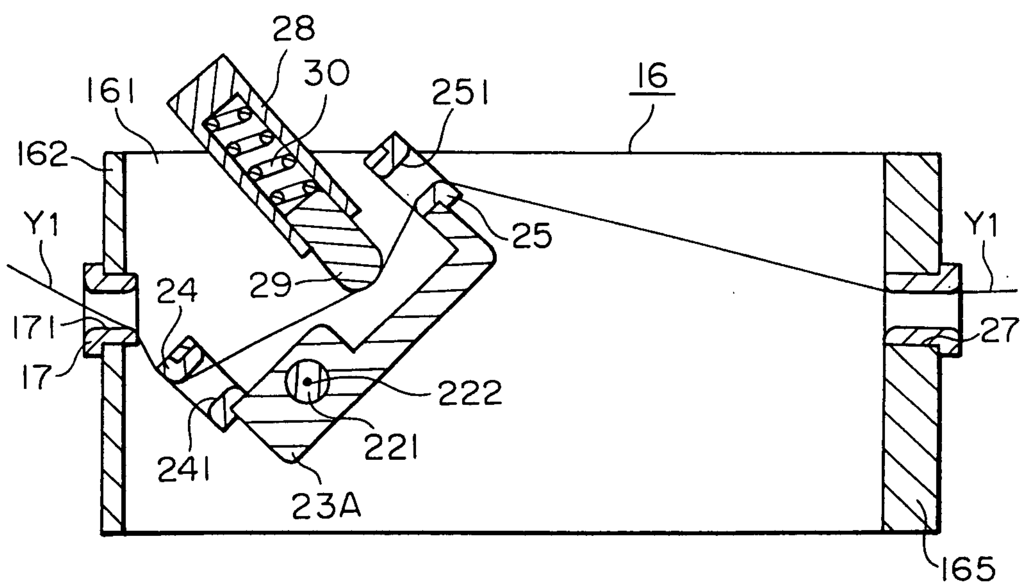
Y1
Y1
24
29
25
171
17
27
222
241
221
23A
165
161

FIG. 10


28
30
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161
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162
Y1
Y1
25
24
29
171
17
27
222
221
241
23A
165

FIG. 11A

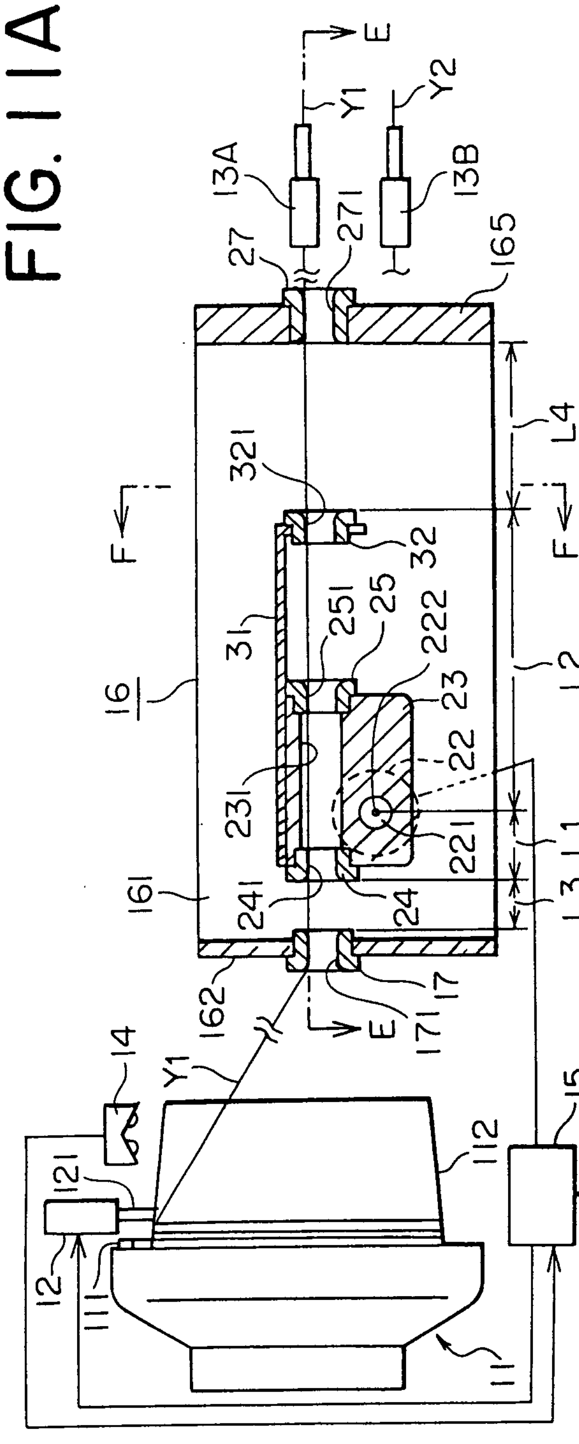


FIG. 11B

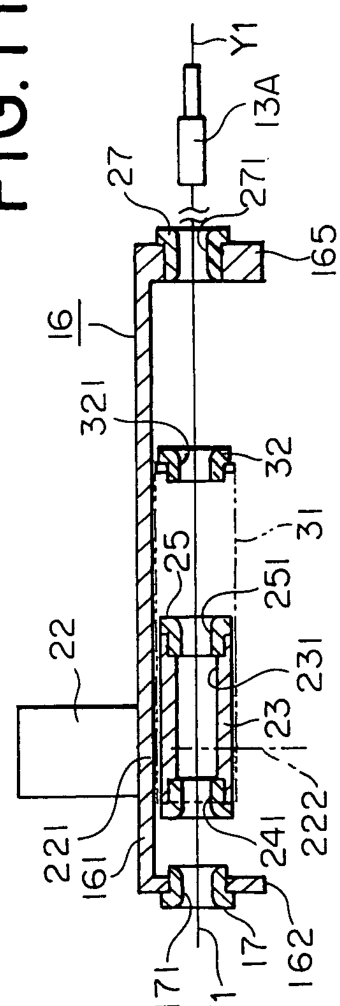


FIG. 12

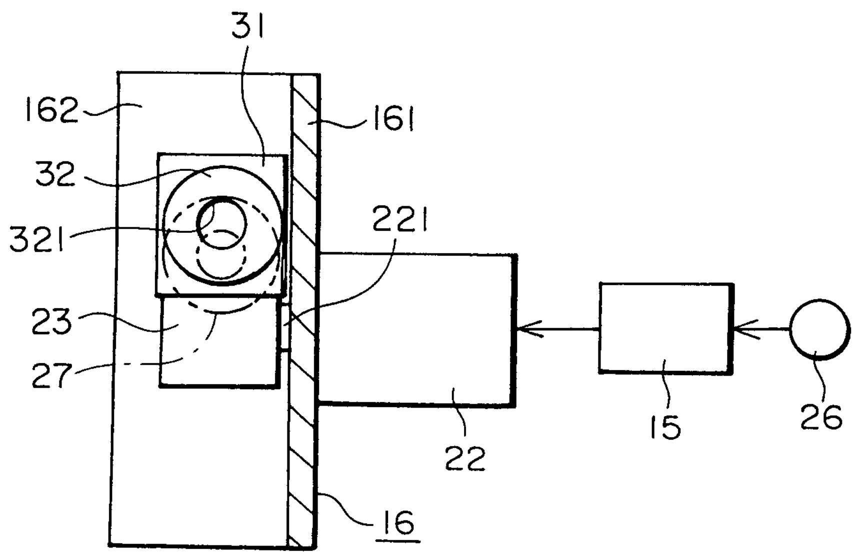
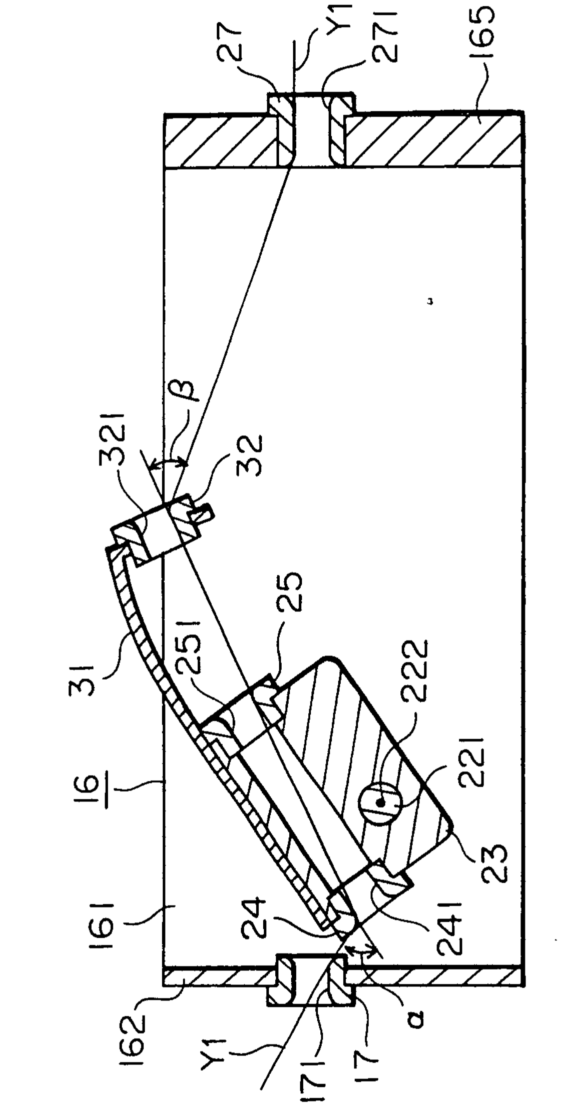
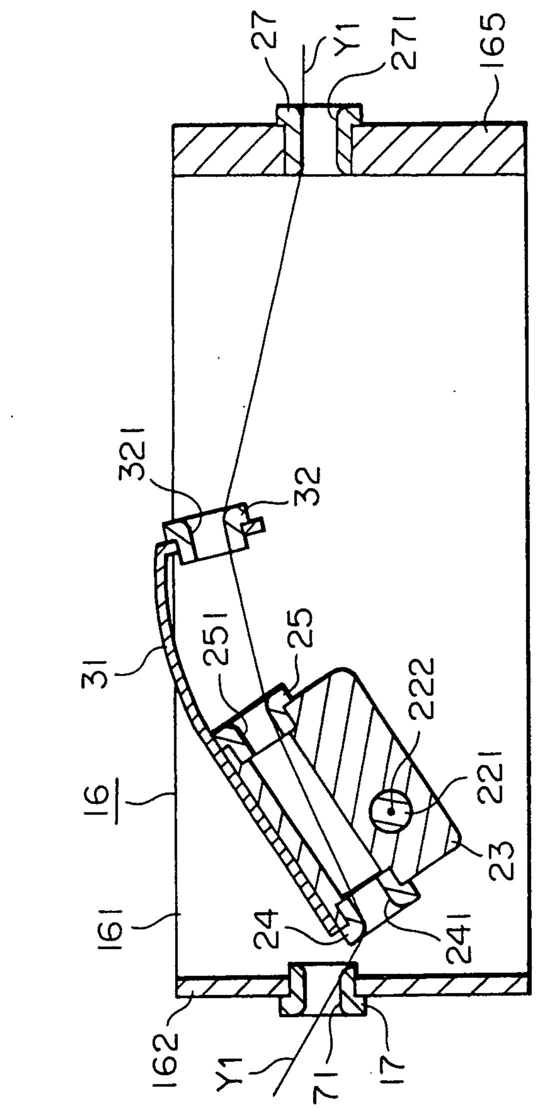


FIG. 13


27
Y1
271
165
β
321
32
25
251
222
31
16
221
161
23
24
241
162
α
Y1
171
17


27
Y1
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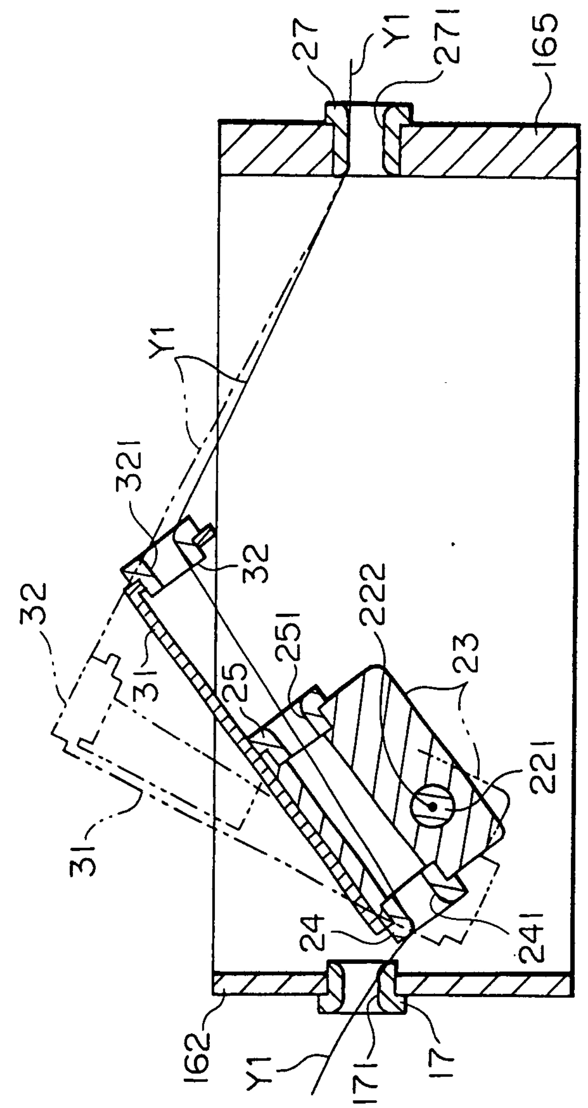
222
16
161
221
23
24
241
162
Y1
171
17

FIG. 14

FIG. 15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Y1
271
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Y1
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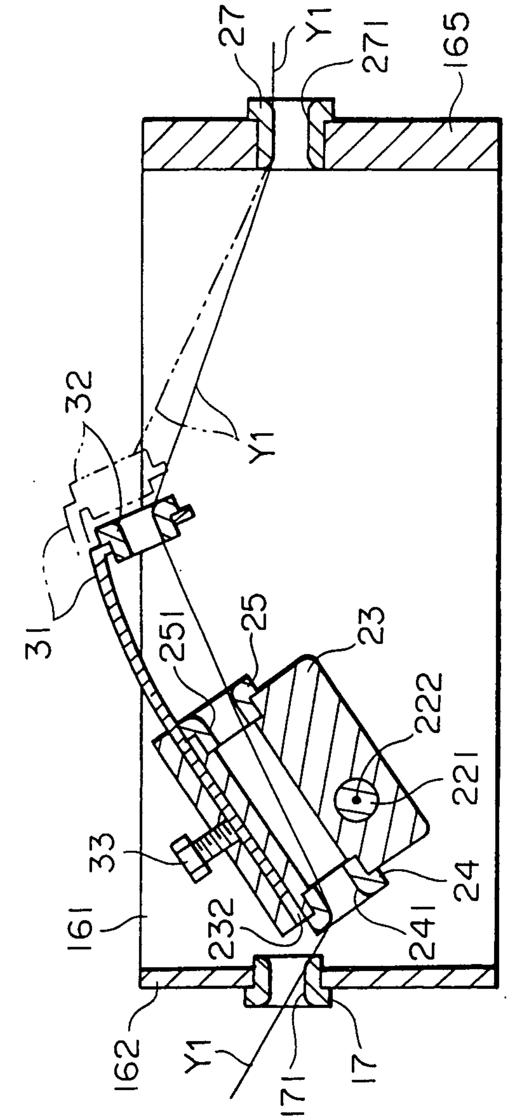
25
31
31
221
24
241
162
Y1
171
17

FIG. 16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Y1
271
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32
Y1
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23
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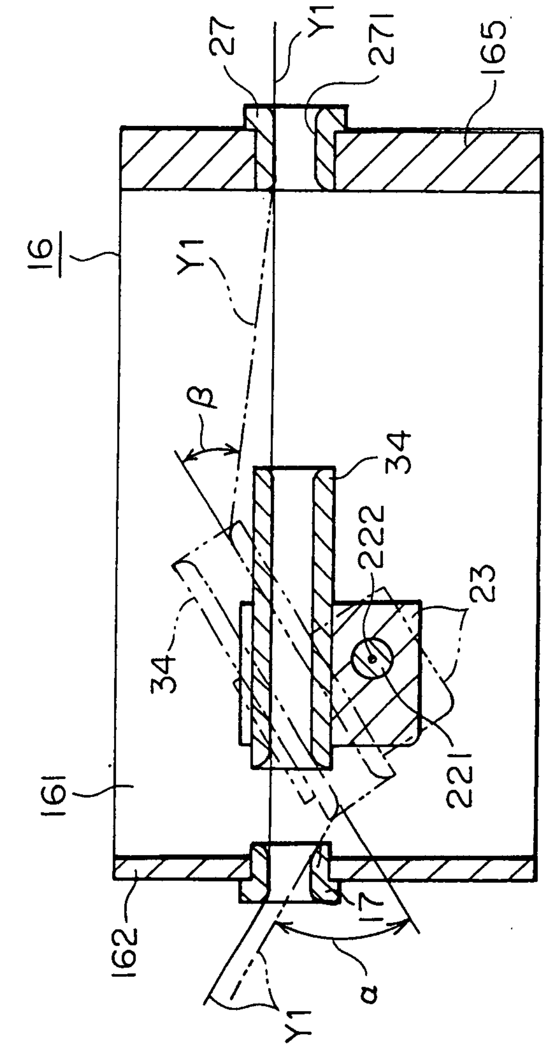
222
221
33
24
161
232
241
162
Y1
171
17

FIG. 17



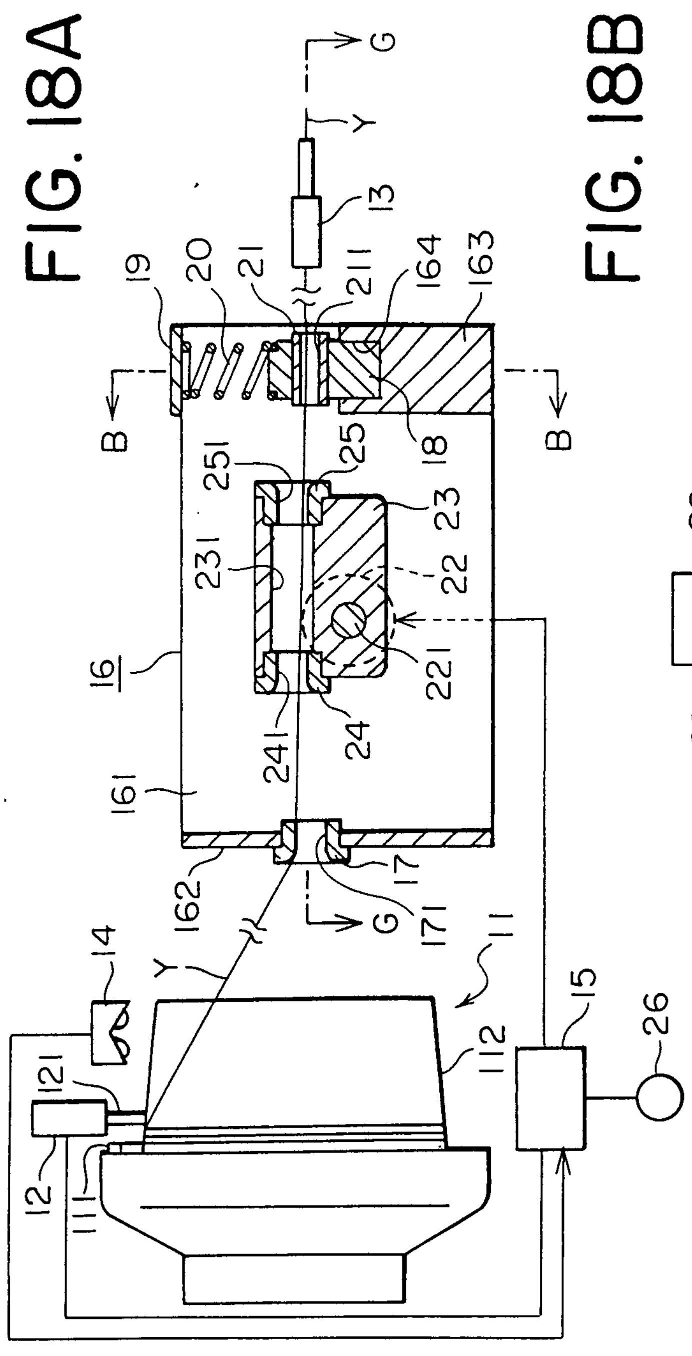


FIG. 18A

FIG. 18B

FIG. 19A

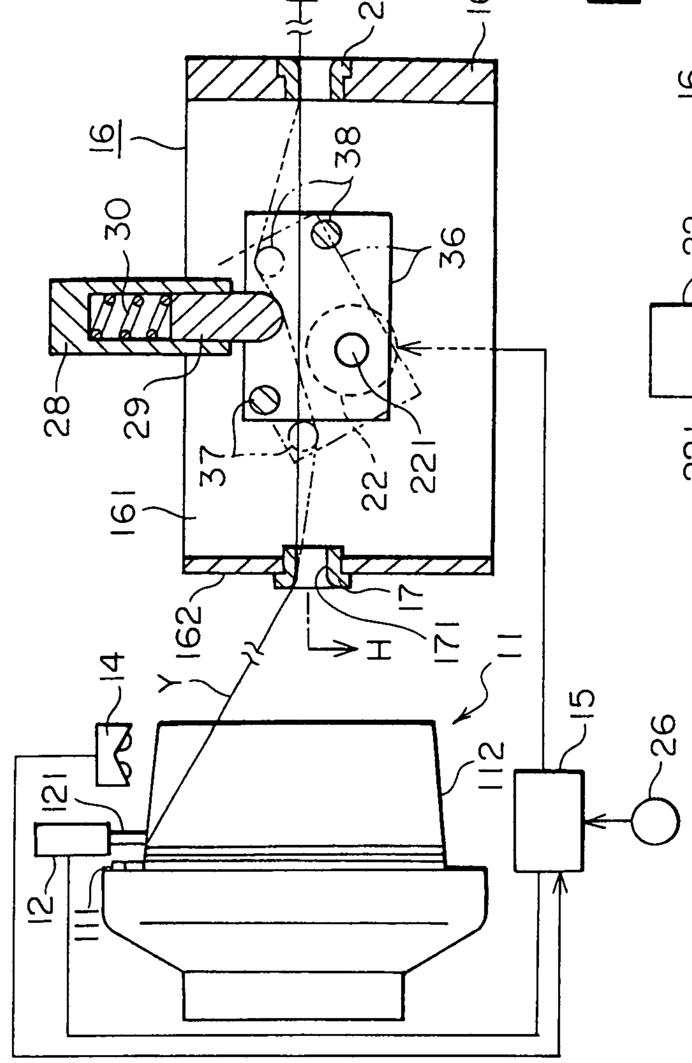


FIG. 19B