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(54) YARN FEEDING MECHANISM OF FLAT KNITTING MACHINE

(57) Upstream-side and downstream-side V-groove guide rollers (24, 25) having substantially V-shaped grooves (241, 251) are rotatably supported in a feeding path in which yarns are formed into a folded yarn by a yarn combining device and is supplied to a yarn carrier. Shafts (242, 252) of the V-groove guide rollers (24, 25) are inclined relative to a direction perpendicular to the feeding path so that the folded yarn is twisted while being rolled from one inclined surfaces (243A, 253A) of the inclined surfaces (243A, 243B, 253A, 253B) of the grooves (241, 251) to valleys. Further, lines (X, Y) tracing the valleys of the grooves (241, 251) of the V-groove guide rollers (24, 25) in a circumferential direction forms one cycle of a sine curve for one turn of the V-groove guide rollers (24, 25) in an expanded state.

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to yarn feeding mechanisms of flat knitting machines, and specifically relates to how to prevent slack of yarn in a feeding path that supplies a plurality of yarns to a yarn carrier.

2. Description of the Related Art

[0002] A technique has been known in which a top tension device or a side tension device is provided in a feeding path through which a yarn fed out from a cone is supplied to a yarn carrier so as to apply tension to the yarn in order to prevent slack of yarn in the feeding path (for example, see Patent Literature 1).

[0003] Further, a technique also has been known in which a plurality of yarns are combined into a folded yarn by a yarn combining device, and the folded yarn is supplied to the yarn carrier via the feeding path.

[0004] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2010-144301

[0005] When the folded yarn is supplied to the yarn carrier via the feeding path, the used amounts of yarns are each different depending on the difference in resistance applied to each of the yarns or the difference between the inner periphery and the outer periphery of the stitch formed during knitting. In that case, it has been proposed to provide a top tension device or a side tension device to increase a tension of the folded yarn in the feeding path so as to eliminate slack yarn which occurs in the yarns with a small amount of use.

[0006] However, if the tension of the folded yarn is excessively increased in accordance with the slack yarn, an adverse effect in knitting may occur in that the yarn which does not have a slack is easily broken or the stitches are narrowed.

SUMMARY OF THE INVENTION

[0007] Accordingly, it is an object of the present invention to provide a yarn feeding mechanism of a flat knitting machine that ensures prevention of slack of yarn in a feeding path without excessively increasing tension of a folded yarn.

[0008] In order to achieve the above object, the present invention assumes a yarn feeding mechanism of a flat knitting machine in which a plurality of yarns are formed into a folded yarn by a yarn combining device and supplied to a yarn carrier. Further, a V-groove guide roller having a substantially V-shaped groove is rotatably supported in the feeding path from the yarn combining device to the yarn carrier. Moreover, it is characterized in that a rotation shaft of the V-groove guide roller is inclined relative to a direction perpendicular to the feeding path so that the folded yarn can be easily rolled from one inclined surface of two inclined surfaces of the groove to a valley.

[0009] Furthermore, a line tracing a valley of the groove of the V-groove guide roller in a circumferential direction may form one cycle of a sine curve for one turn of the V-groove guide roller in an expanded state.

[0010] Furthermore, an active yarn feeder may be disposed in the feeding path so as to actively feed the folded yarn to the V-groove guide roller depending on the demand.

[0011] Furthermore, an inclined angle changing mechanism may be disposed to change the inclined angle of the rotation shaft of the V-groove guide roller relative to the direction perpendicular to the feeding path.

[0012] Further, a downstream-side V-groove guide roller having a substantially V-shaped groove is rotatably supported in the feeding path at a position close to the yarn carrier than to the V-groove guide roller. The rotation shaft of the downstream-side V-groove guide roller may be inclined in the direction opposite to the inclined direction of the V-groove guide roller with respect to the direction perpendicular to the feeding path so that the folded yarn rolled by the V-groove guide roller is rolled in the opposite direction.

[0013] Alternatively, a downstream-side recessed groove guide roller having a recess-shaped flat groove that is in contact with the folded yarn at the bottom is rotatably supported in the feeding path at a position close to the yarn carrier than to the V-groove guide roller. A rotation shaft of the downstream-side recessed groove guide roller may be perpendicular to the feeding path such that the folded yarn rolled by the V-groove guide roller is fed out without being twisted while being in contact with the flat groove.

[0014] Since the rotation shafts of the V-groove guide rollers are inclined in the direction perpendicular to the feeding path so that the folded yarn from the yarn combining device is easily rolled from one inclined surface of the groove of the V-groove guide roller to the valley, the folded yarn is twisted in the feeding path and thus firmly twisted. Accordingly, it is possible to ensure prevention of slack of yarn in the feeding path without excessively increasing the tension of the folded yarn.

[0015] Further, since the line tracing a valley of the groove of the V-groove guide roller in the circumferential direction forms one cycle of a sine curve for one turn of the V-groove guide roller in an expanded state, the valley of the groove meanderingly moves between the inclined surfaces during one turn of the V-groove guide roller, causing the inclined angles of the respective inclined surfaces to vary. Meanwhile, since the folded yarn rolls only on one inclined surface, the folded yarn is rolled on the one inclined surface and is twisted when the valley moves to the other inclined surface with rotation of the V-groove guide rollers and the inclined angle of the one inclined surface becomes gently inclined. When the valley moves to one inclined surface and the inclined angle of one inclined surface become steeply inclined, the folded yarn

moves to one inclined surface. However, when the valley move back to the other inclined surface and the inclined angle of one inclined surface become gently inclined, the folded yarn is again rolled on the one inclined surface and twisted. Accordingly, twisting of the folded yarn is facilitated by using only one inclined surface of the groove of the V-groove guide roller so that the folded yarn can be smoothly twisted in the feeding path to the yarn carrier.

[0016] Further, since the active yarn feeder is provided so as to actively feed the folded yarn to the V-groove guide roller depending on the demand, the folded yarn actively fed can also be rolled from the inclined surface of the groove of the V-groove guide roller to the valley and can be smoothly twisted in the feeding path.

[0017] Further, since the inclined angle changing mechanism changes the inclined angle of the rotation shaft of the V-groove guide roller relative to the direction perpendicular to the feeding path, which of the inclined surfaces of the groove of the V-groove guide roller is to be used or the degree of twisting of the folded yarn can be changed depending on the types of the yarns. Accordingly, the degree of twisting of the folded yarn can be increased or decreased depending on the thickness, the types or the knitting conditions of the yarns.

[0018] Further, since the rotation shaft of the downstream-side V-groove guide roller located at a position close to the yarn carrier than to the V-groove guide roller in the feeding path is inclined in the direction opposite to the inclined direction of the V-groove guide roller with respect to the direction perpendicular to the feeding path so that the folded yarn which is rolled and twisted by the V-groove guide roller is rolled in the opposite direction from one inclined surface to the valley of the groove of the downstream-side V-groove guide roller, the folded yarn can be further twisted between both guide rollers and thus firmly twisted, thereby ensuring prevention of slack of the yarns in the feeding path.

[0019] Moreover, since the rotation shaft of the downstream-side V-groove guide roller is inclined in the direction opposite to the inclined direction of the V-groove guide roller with respect to the direction perpendicular to the feeding path, the folded yarn from the downstream-side V-groove guide roller to the knitting needle can also be twisted, and accordingly, knitting can be performed by the knitting needle while the folded yarn is in a twisted state.

[0020] Alternatively, the rotation shaft of the downstream-side recessed groove guide roller located at a position close to the yarn carrier than to the V-groove guide roller in the feeding path is perpendicular to the feeding path so that the folded yarn twisted by the V-groove guide roller is fed out without being twisted while being in contact with the flat groove of the downstream-side recessed groove guide roller. Accordingly, the folded yarn can be further twisted between both guide rollers and thus firmly twisted, thereby ensuring prevention of slack of the yarns in the feeding path.

[0021] Moreover, when the folded yarn twisted by the V-groove guide roller is fed out without being twisted while being in contact with the flat groove of the downstream-side recessed groove guide roller, twist of the folded yarn after it is in contact with the flat groove naturally returns. Accordingly, twist of the folded yarn between the rollers can be released at a position from the downstream-side recessed groove guide roller to the knitting needle so that knitting by the knitting needle can be performed in the state in which twist of the folded yarn is released.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Fig. 1 is a schematic configuration view which schematically shows a configuration of a yarn feeding mechanism of a flat knitting machine according to an embodiment of the present invention;

Fig. 2 is a configuration view which shows a detailed configuration of a feeding path;

Fig. 3 is a rear view of the upstream-side guide device seen from a position at which the yarn carrier is not located;

Fig. 4 is a plan view of the downstream-side guide device seen from above;

Fig. 5 is a front view of the upstream-side and downstream-side V-groove guide rollers seen in the direction perpendicular to the shafts;

Fig. 6 is a vertical cross sectional front view of the upstream-side and downstream-side V-groove guide rollers;

Fig. 7 is an explanatory view which explains a twisting direction of the folded yarn by the upstream-side and downstream-side V-groove guide rollers in the feeding path;

Fig. 8 is an explanatory view which explains the shape of grooves of the upstream-side and downstream-side V-groove guide rollers in an expanded state; and

Fig. 9 is a schematic configuration view which schematically shows a configuration of a yarn feeding mechanism of the flat knitting machine according to a modification example of the present embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] With reference to the drawings, an embodiment of the present invention will be described.

[0024] Fig. 1 is a schematic configuration view which schematically shows a configuration of a yarn feeding mechanism of a flat knitting machine according to an embodiment of the present invention; and Fig. 2 is a configuration view which shows a detailed configuration of a feeding path.

[0025] In Figs. 1 and 2, a flat knitting machine 1 includes a yarn feeding mechanism 2 that supplies yarns 12A, 12B fed out from two cones 11A, 11B, respectively,

to a knitting needle, which is not shown in the figure. The yarn feeding mechanism 2 includes a yarn carrier 3 that slides relative to a rail which extends in a direction parallel to a traveling direction of a carriage, which is not shown in the figure. The yarn carrier 3 includes a base 31 and a single yarn feeding arm 32 which extends downward from the base 31. A yarn feeding port 33 is provided on the lower end of the yarn feeding arm 32.

[0026] Further, the yarn feeding mechanism 2 includes a yarn combining device 21 that combines two yarns 12A, 12B fed out from the respective corns 11A, 11B into a folded yarn 12, and upstream-side and downstream-side guide devices 22, 23 that guide the folded yarn 12 from the yarn combining device 21 to the yarn carrier 3. Further, an active yarn feeder 4 is disposed in the feeding path 20 between the yarn combining device 21 and the yarn carrier 3 so as to actively feed the folded yarn 12 from the yarn combining device 21 to the upstream-side guide device 22 depending on the demand. The active yarn feeder 4 includes a main roller 41 that is rotated by a servo motor 40, and a driven roller 42 connected to the servo motor 40 via a driven mechanism (not shown in the figure) to rotate synchronously with the main roller 41. The folded yarn 12 from the yarn combining device 21 is actively fed out while being nipped between the rollers 41, 42.

[0027] Further, the active yarn feeder 4 includes a side tension device 44. The side tension device 44 includes a pivotally movable buffer rod 45 biased in a direction which allows the folded yarn 12 to be withdrawn out of the feeding path 20 (counterclockwise direction in Fig. 1) so that the biasing force applies tension to the folded yarn 12.

[0028] Fig. 3 is a rear view of the upstream-side guide device seen from a position at which the yarn carrier 3 is not located, and Fig. 4 is a plan view of the downstream-side guide device seen from above. As shown in Fig. 3, the upstream-side guide device 22 is disposed between the active yarn feeder 4 and the yarn carrier 3 in the feeding path 20. The upstream-side guide device 22 includes an L-shaped frame 221 which is fixed to the housing 2a of the yarn feeding mechanism 2, and an upstream-side V-groove guide roller 24 (V-groove guide roller) which has a substantially V-shaped groove 241 and is provided with a shaft 242 (rotation shaft) rotatably supported by a support arm 222 which is supported by the L-shaped frame 221. Further, as shown in Fig. 4, the downstream-side guide device 23 includes a guide support member 231 which is elongated in the width direction and is mounted on the yarn feeding arm 32 of the yarn carrier 3, and a downstream-side V-groove guide roller 25 which has a substantially V-shaped groove 251 and is provided with a shaft 252 (rotation shaft) rotatably supported at one end of the guide support member 231 in the width direction (right end in Fig. 2).

[0029] Fig. 5 is a front view of the upstream-side and downstream-side V-groove guide rollers 24, 25 seen in the direction perpendicular to the shafts 242, 252, and Fig. 6 is a vertical cross sectional front view of the upstream-side and downstream-side V-groove guide rollers 24, 25. As shown in Figs. 5 and 6, the upstream-side V-groove guide roller 24 includes two inclined surfaces 243A, 243B on each side of the groove 241, and the downstream-side V-groove guide roller 25 includes two inclined surfaces 253A, 253B on each side of the groove 251.

[0030] As shown in Fig. 3, the shaft 242 of the upstream-side V-groove guide roller 24 is gently inclined (for example, inclined by approximately 10 degrees) relative to the substantially horizontal direction (left-right direction in Fig. 3) which is perpendicular to the folded yarn 12 supplied from the feeding path 20 which extends in the substantially vertical direction (up-down direction in Fig. 3). Further, as shown in Fig. 4, the shaft 252 of the downstream-side V-groove guide roller 25 is gently inclined (for example, inclined by approximately 10 degrees) relative to the direction (up-down direction in Fig. 4) which is perpendicular to the folded yarn 12 supplied from the feeding path 20 which extends in the substantially horizontal direction (left-right direction in Fig. 4). This facilitates rolling of the folded yarn 12 from the inclined surfaces 243A, 253A, which are one of the inclined surfaces 243A and 243B, 253A and 253B of the grooves 241, 251 of the upstream-side and downstream-side V-groove guide rollers 24, 25 to the respective valleys.

[0031] Fig. 7 is an explanatory view which explains a twisting direction of the folded yarn 12 by the upstream-side and downstream-side V-groove guide rollers 24, 25 in the feeding path 20. In Fig. 7, inclination of the shaft 242 of the upstream-side V-groove guide roller 24 facilitates rolling of the folded yarn 12 from one inclined surface 243A of the groove 241 to the valley. Accordingly, the folded yarn 12 which is twisted in clockwise direction (the arrow direction indicated by the one-dotted chain line in Fig. 7) in the feeding path 20 to the yarn carrier 3 can be firmly twisted, thereby ensuring prevention of slack of the yarns 12A, 12B in the feeding path 20 without excessively increasing the tension of the folded yarn 12.

[0032] Further, the shaft 252 of the downstream-side V-groove guide roller 25 is inclined in the direction opposite to the inclined direction of the upstream-side V-groove guide roller 24 with respect to the direction perpendicular to the feeding path 20 so that the folded yarn 12 twisted by the upstream-side V-groove guide roller 24 is rolled in the opposite direction. Accordingly, the folded yarn 12 twisted by the upstream-side V-groove guide roller 24 is rolled from one inclined surface 253A of the groove 251 of the downstream-side V-groove guide roller 25 to the valley in the opposite direction so as to be twisted in the counterclockwise direction (the arrow direction indicated by the two-dotted chain line in Fig. 7) in the feeding path 20. As a result, the folded yarn 12 can be further twisted between the upstream-side V-groove guide roller 24 and the downstream-side V-groove guide roller 25 so that the folded yarn 12 is firmly twisted, thereby ensuring prevention of slack of the yarns 12A, 12B in

the feeding path 20.

[0033] Moreover, since the shaft 252 of the downstream-side V-groove guide roller 25 is inclined in the direction opposite to the inclined direction of the shaft 242 of the upstream-side V-groove guide roller 24 with respect to the direction perpendicular to the feeding path 20, the folded yarn 12 from the downstream-side V-groove guide roller 25 to the knitting needle can also be twisted. Accordingly, knitting can be performed by the knitting needle while the folded yarn 12 is in a twisted state.

[0034] Fig. 8 is an explanatory view which explains the shape of the grooves 241, 251 of the upstream-side and downstream-side V-groove guide rollers 24, 25 in an expanded state. In Fig. 8, lines X, Y tracing the valleys of the grooves 241, 251 of the upstream-side and downstream-side V-groove guide rollers 24, 25, respectively, in the circumferential direction are shown in the expanded state in which one turn of the V-groove guide rollers 24, 25 is one cycle of a sine curve. As the lines X, Y move meanderingly within the range of W between the inclined surfaces 243A and 243B, 253A and 253B of the direction of the shafts 242, 252, respectively, along the sine curve, the inclined angles of the respective inclined surfaces 243A, 243B, 253A, 253B of the grooves 241, 251 vary. Meanwhile, the folded yarn 12 rolls only on one inclined surfaces 243A, 253A of the inclined surfaces of the grooves 241, 251 of the upstream-side and downstream-side V-groove guide rollers 24, 25. Accordingly, when the valleys of the grooves 241, 251 move to the other inclined surfaces 243B, 253B and the inclined angles of the one inclined surfaces 243A, 253A become gently inclined, the folded yarn 12 is rolled on the one inclined surfaces 243A, 253A so as to be twisted. Furthermore, when the valleys move to one inclined surfaces 243A, 253A with rotation of the V-groove guide rollers 24, 25 and the inclined angles of one inclined surfaces 243A, 253A become steeply inclined, the folded yarn 12 moves to one inclined surfaces 243A, 253A. However, when the valleys move back to the other inclined surfaces 243B, 253B and the inclined angles of one inclined surfaces 243A, 253A become gently inclined, the folded yarn 12 is again rolled on the one inclined surfaces 243A, 253A so as to be twisted. Accordingly, twisting of the folded yarn 12 is facilitated by using only one inclined surfaces 243A, 253A of the grooves 241, 251 of the upstream-side and downstream-side V-groove guide rollers 24, 25. As a result, the folded yarn 12 can be smoothly twisted in the feeding path 20 to the yarn carrier 3.

[0035] Furthermore, an inclined angle changing mechanism 26 is disposed in the upstream-side guide device 22 to change the inclined angle of the shaft 242 of the upstream-side V-groove guide roller 24 relative to the direction perpendicular to the feeding path 20. The inclined angle changing mechanism 26 includes a screw member 261 that fasten the support arm 222 to the L-shaped frame 221 and is configured to change inclined angle of the shaft 242 of the upstream-side V-groove guide roller 24 relative to the direction perpendicular to the feeding path 20 when the support arm 222 rotates about the axis of the screw member 261. Accordingly, which of the inclined surfaces 243A, 243B of the groove 241 of the upstream-side V-groove guide roller 24 is to be used or the degree of twisting can be decided depending on the types of yarns 12A, 12B. Therefore, the degree of twisting of the folded yarn 12 can be increased or decreased depending on the thickness, the types or the knitting conditions of the yarns 12A, 12B.

[0036] Furthermore, in order to enhance wear resistance, the inclined surfaces 243A, 243B, 253A, 253B of the upstream-side and downstream-side V-groove guide rollers 24, 25 are processed with a treatment (such as plating) for improving smooth sliding of the folded yarn 12. Accordingly, as shown in Fig. 8, notches 244, 254 are formed on the inclined surfaces 243A, 243B, 253A, 253B of the grooves 241, 251 of the upstream-side and downstream-side V-groove guide rollers 24, 25 at positions separated by 180 degrees from each other in the circumferential direction and close to the peak of the most gently inclined surface, and the notches 244, 254 have substantially L-shaped cross sections which are linearly notched in a direction perpendicular to the shafts 242, 252. As a result, even if the inclined surfaces 243A, 243B, 253A, 253B of the upstream-side and downstream-side V-groove guide rollers 24, 25 are processed with a treatment for smooth sliding, the folded yarn 12 can be easily latched in the notches 244, 254 so that the folded yarn 12 can be efficiently rolled and twisted on gently inclined one inclined surfaces 243A, 253A from a position close to the peak to the valley.

[0037] In the above embodiment of the present invention, the active yarn feeder 4 is provided in the feeding path 20. However, as shown in Fig. 9, only the side tension device 44 may be provided in the feeding path 20 between the yarn combining device 21 and the upstream-side guide device 22.

[0038] Further, in the above embodiment, the upstream-side and downstream-side V-groove guide rollers 24, 25 have the lines X, Y which trace the valleys of the grooves 241, 251, respectively, in the circumferential direction, and are shown in the expanded state in which one turn of the V-groove guide rollers 24, 25 is one cycle of a sine curve. However, the upstream-side and downstream-side V-groove guide rollers may also be used in which the line tracing the valley of the substantially V-shaped groove in the circumferential direction is provided on the same plane perpendicular to the rotation center of the groove, and each of the peak-side ends of the inclined surfaces are eccentric such that two points spaced from each other by the same distance in the radially outward direction on the above plane from the rotation center of the groove on the straight line passing through the rotation center of the groove are provided as the respective centers. In this case, although the line tracing the valley of the groove in the circumferential direction is in straight shape without meandering in the rotation

shaft direction, the inclined surfaces of the grooves alternately provide a gently inclined surface that allows for easy rolling at positions separated from each other by 180 degrees in the circumferential direction during one turn of the V-groove guide roller.

[0039] Further, in the above embodiment, the notches 244, 254 are provided on the inclined surfaces 243A, 243B, 253A, 253B of the grooves 241, 251 of the upstream-side and downstream-side V-groove guide rollers 24, 25 at positions separated from each other by 180 degrees in the circumferential direction and close to the peak of the most gently inclined surface. However, instead of the notches, bump shaped projections that protrude outward may also be provided so as to facilitate latching of the folded yarn.

[0040] Further, in the above embodiment, the inclined surfaces 243A, 243B, 253A, 253B of the upstream-side and downstream-side V-groove guide rollers 24, 25 are processed with a treatment that allows for smooth sliding of the folded yarn 12. However, the inclined surfaces of the upstream-side and downstream-side V-groove guide rollers may be processed with a treatment that is resistant to sliding. In this case, since the folded yarn is facilitated to roll on the inclined surface to the valley, the notches or the projections may not be provided at positions close to the peak of the most gently inclined surface.

[0041] Further, in the above embodiment, the upstream-side and downstream-side V-groove guide rollers 24, 25 having the same configuration are provided in the feeding path 20. However, only the upstream-side V-groove guide roller may be configured in which a line tracing the valley of the groove in the circumferential direction have one cycle of a sine curve for one turn of the V-groove guide roller in an expanded state, and the downstream-side V-groove guide roller may be an ordinary roller in which a line tracing the valley of the groove in the circumferential direction corresponds to the direction perpendicular to the shaft of the roller.

[0042] Alternatively, instead of the downstream-side V-groove guide roller, the downstream-side recessed groove guide roller may be used which has a recess-shaped flat groove that is in contact with the folded yarn at the bottom, and the rotation shaft of the downstream-side recessed groove guide roller is perpendicular to the feeding path such that the folded yarn rolled by the upstream-side V-groove guide roller is fed out while being in contact with the flat groove. In this case, the folded yarn twisted by the upstream-side V-groove guide roller is fed out without being twisted while being in contact with the flat groove of the downstream-side recessed groove guide roller. Accordingly, the folded yarn between the upstream-side V-groove guide roller and the downstream-side recessed groove guide roller can be further twisted and thus firmly twisted, thereby ensuring prevention of slack of yarn in the feeding path. Moreover, since the rotation shaft of the downstream-side recessed groove guide roller is perpendicular to the feeding path, twist of the folded yarn after it is in contact with the flat groove naturally returns when the folded yarn twisted by the upstream-side V-groove guide roller is fed out without being twisted while being in contact with the flat groove of the downstream-side recessed groove guide roller, and twist of the folded yarn between the rollers can be released at a position from the downstream-side recessed groove guide roller to the knitting needle so that knitting by the knitting needle can be performed in the state in which twist of the folded yarn is released.

[0043] Further, in the above embodiment, two yarns 12A, 12B are folded by the yarn combining device 21 into the folded yarn 12. However, three or more yarns may be used to provide the folded yarn by the yarn combining device.

Claims

1. A yarn feeding mechanism (2) of a flat knitting machine (1) in which a plurality of yarns (12A, 12B) are formed into a folded yarn (12) by a yarn combining device (21) and supplied to a yarn carrier (3), wherein a V-groove guide roller (24) having a substantially V-shaped groove (241) is rotatably supported in a feeding path (20) from the yarn combining device (21) to the yarn carrier (3), and a rotation shaft (242) of the V-groove guide roller (24) is inclined relative to a direction perpendicular to the feeding path (20) so that the folded yarn (12) can be easily rolled from one inclined surface (243A) of two inclined surfaces (243A, 243B) of the groove (241) to a valley.

2. The yarn feeding mechanism of the flat knitting machine according to claim 1, wherein a line (X) tracing a valley of the groove (241) of the V-groove guide roller (24) in a circumferential direction forms one cycle of a sine curve for one turn of the V-groove guide roller (24) in an expanded state.

3. The yarn feeding mechanism of the flat knitting machine according to claim 1 or 2, wherein an active yarn feeder (4) is disposed in the feeding path (20) so as to actively feed the folded yarn (12) to the V-groove guide roller (24) depending on a demand.

4. The yarn feeding mechanism of the flat knitting machine according to any one of claims 1 to 3, wherein an inclined angle changing mechanism (26) is disposed to change an inclined angle of the rotation shaft (242) of the V-groove guide roller (24) relative to the feeding path (20).

5. The yarn feeding mechanism of the flat knitting machine according to any one of claims 1 to 4, wherein a downstream-side V-groove guide roller (25) having a substantially V-shaped groove (251) is rotatably supported in the feeding path (20) at a position close to the yarn carrier (3) than to the V-groove guide

roller (24), and a rotation shaft (252) of the downstream-side V-groove guide roller (25) is inclined in a direction opposite to an inclined direction of the V-groove guide roller (24) with respect to a direction perpendicular to the feeding path (20) so that the folded yarn (12) rolled by the V-groove guide roller (24) is rolled in an opposite direction.

6. The yarn feeding mechanism of the flat knitting machine according to any one of claims 1 to 4, wherein a downstream-side recessed groove guide roller having a recess-shaped flat groove that is in contact with the folded yarn at the bottom is rotatably supported in the feeding path (20) at a position close to the yarn carrier (3) than to the V-groove guide roller (24), and a rotation shaft of the downstream-side recessed groove guide roller is perpendicular to the feeding path (20) such that the folded yarn (12) rolled by the V-groove guide roller (24) is fed out without being twisted while being in contact with the flat groove.

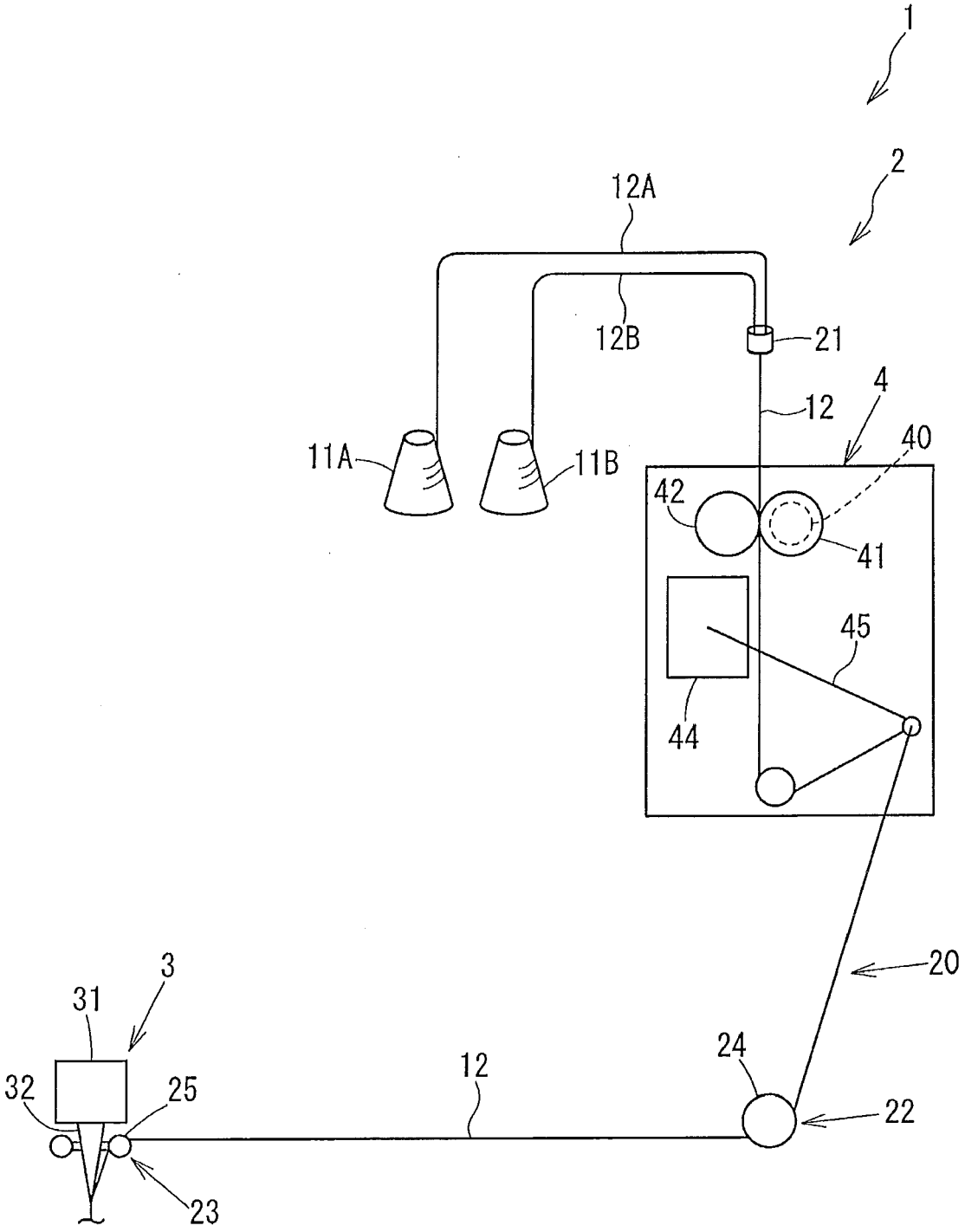

Fig. 1

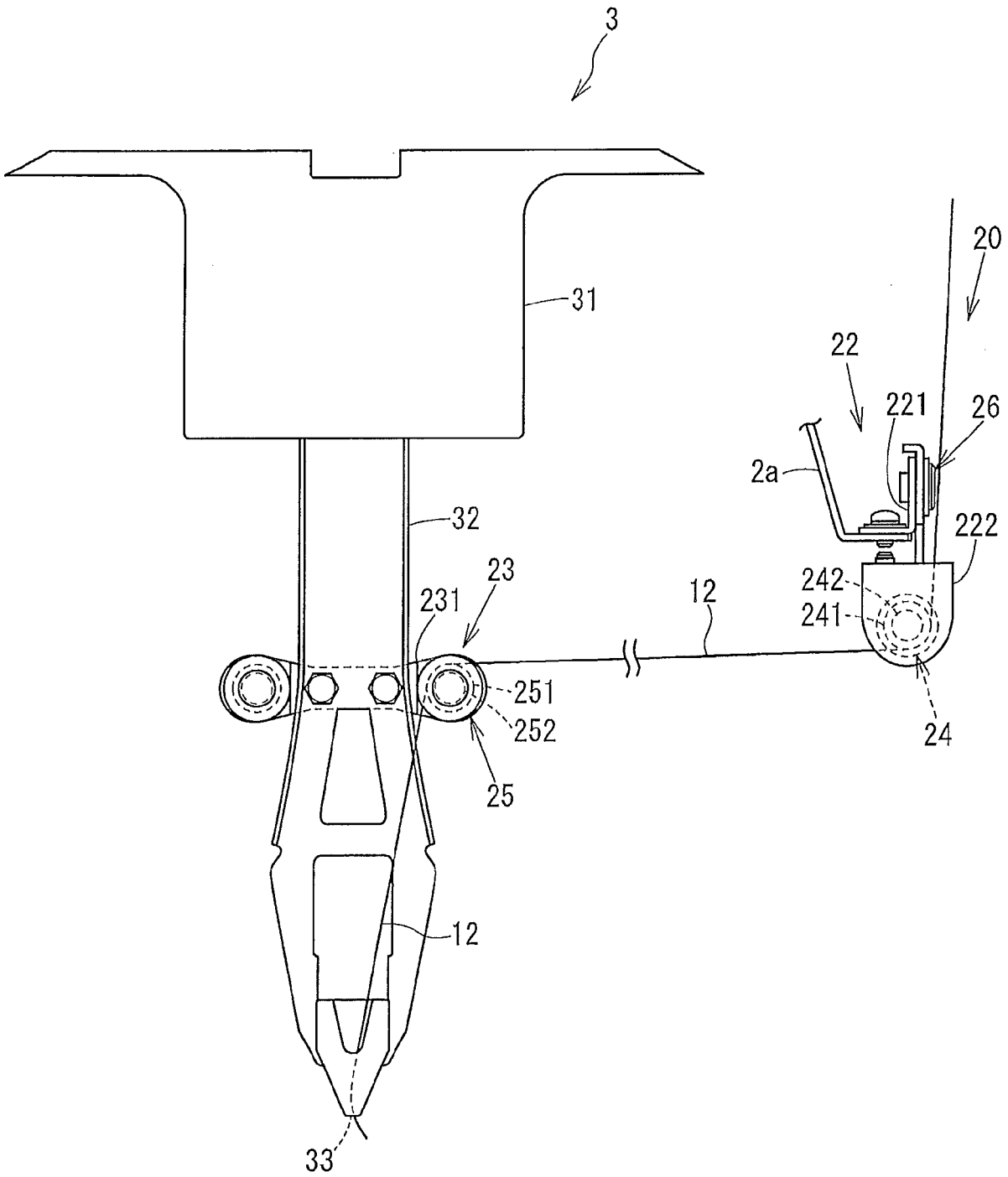

Fig. 2

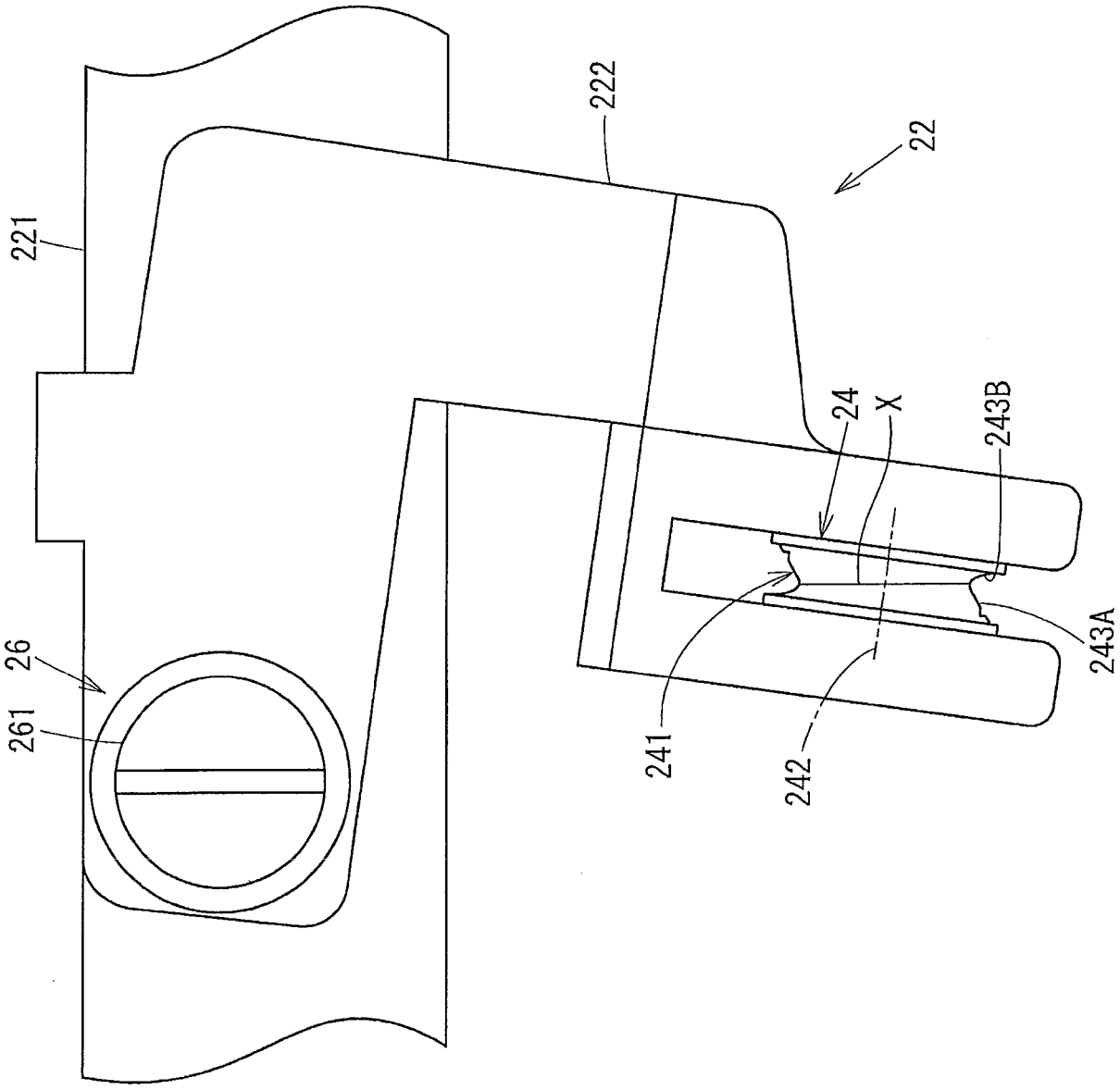

Fig. 3

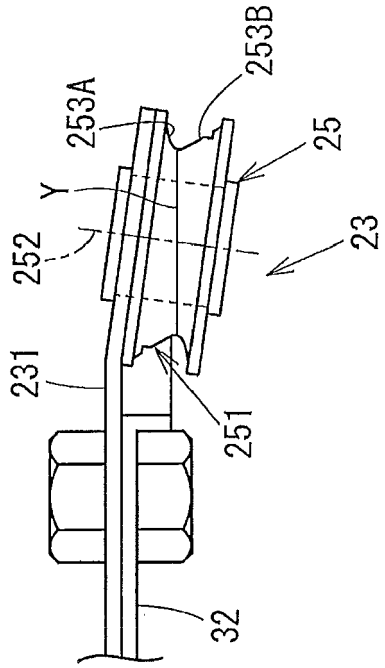

Fig. 4

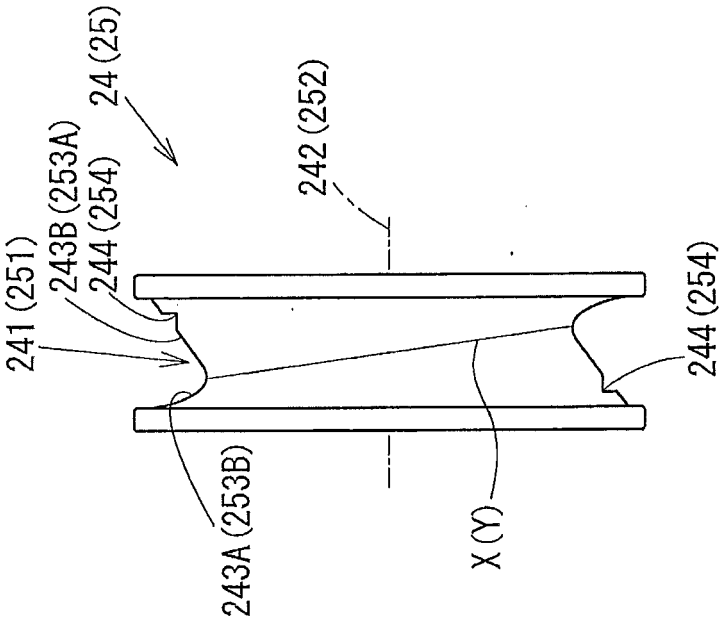

Fig. 5

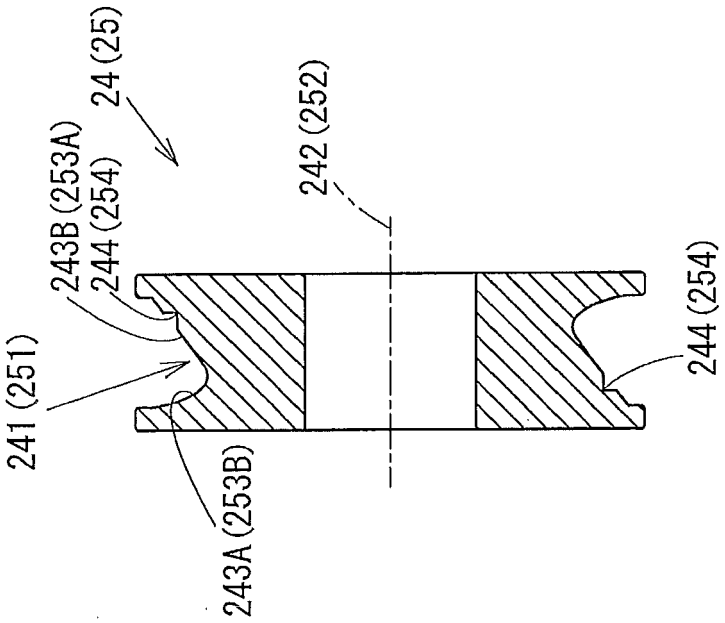

Fig. 6

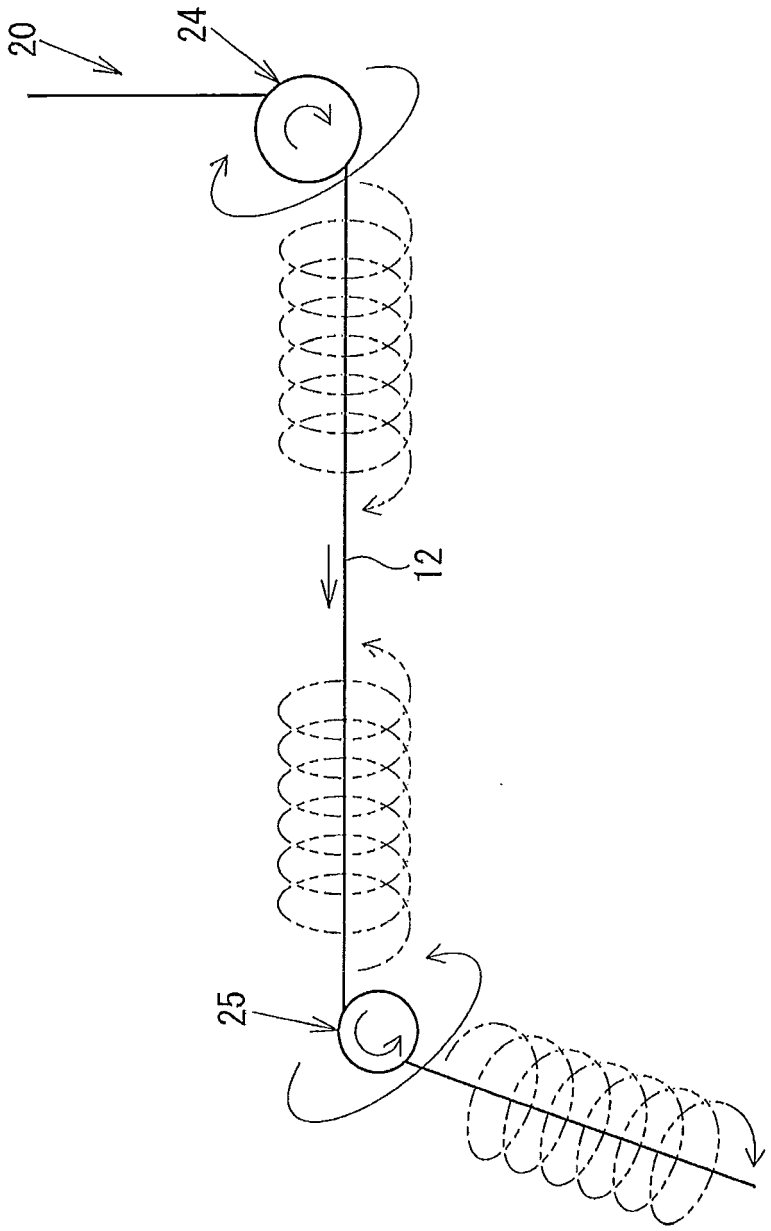

Fig. 7

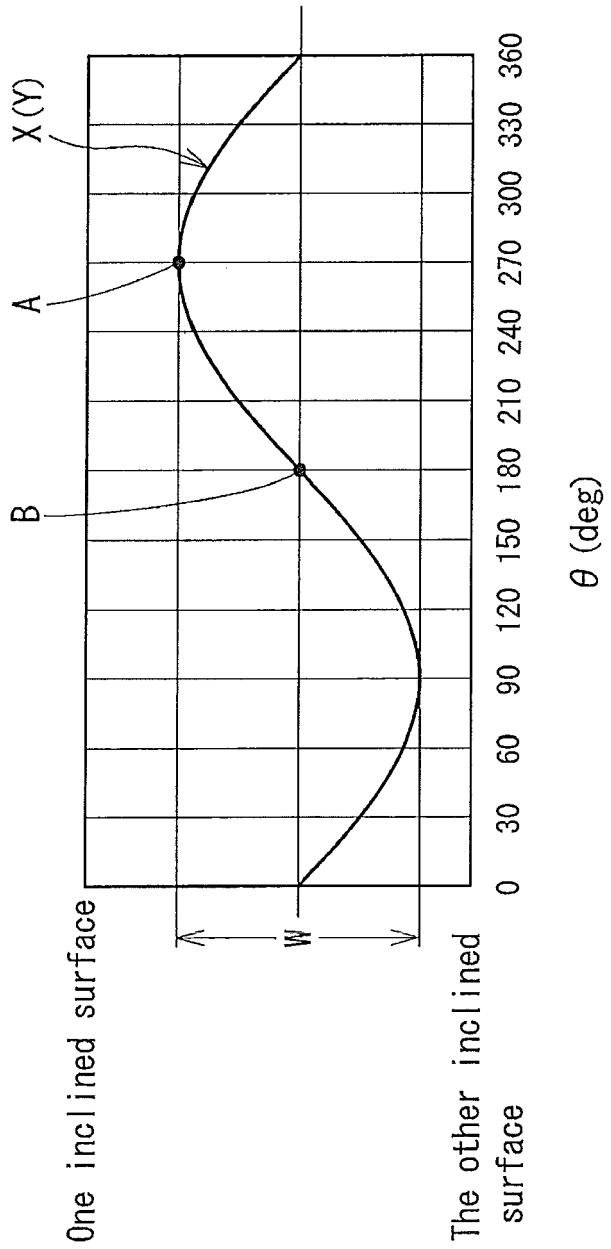
X (Y)
A
B
One inclined surface
W
The other inclined surface
0
30
60
90
120
150
180
210
240
270
300
330
360
θ (deg)

Fig. 8

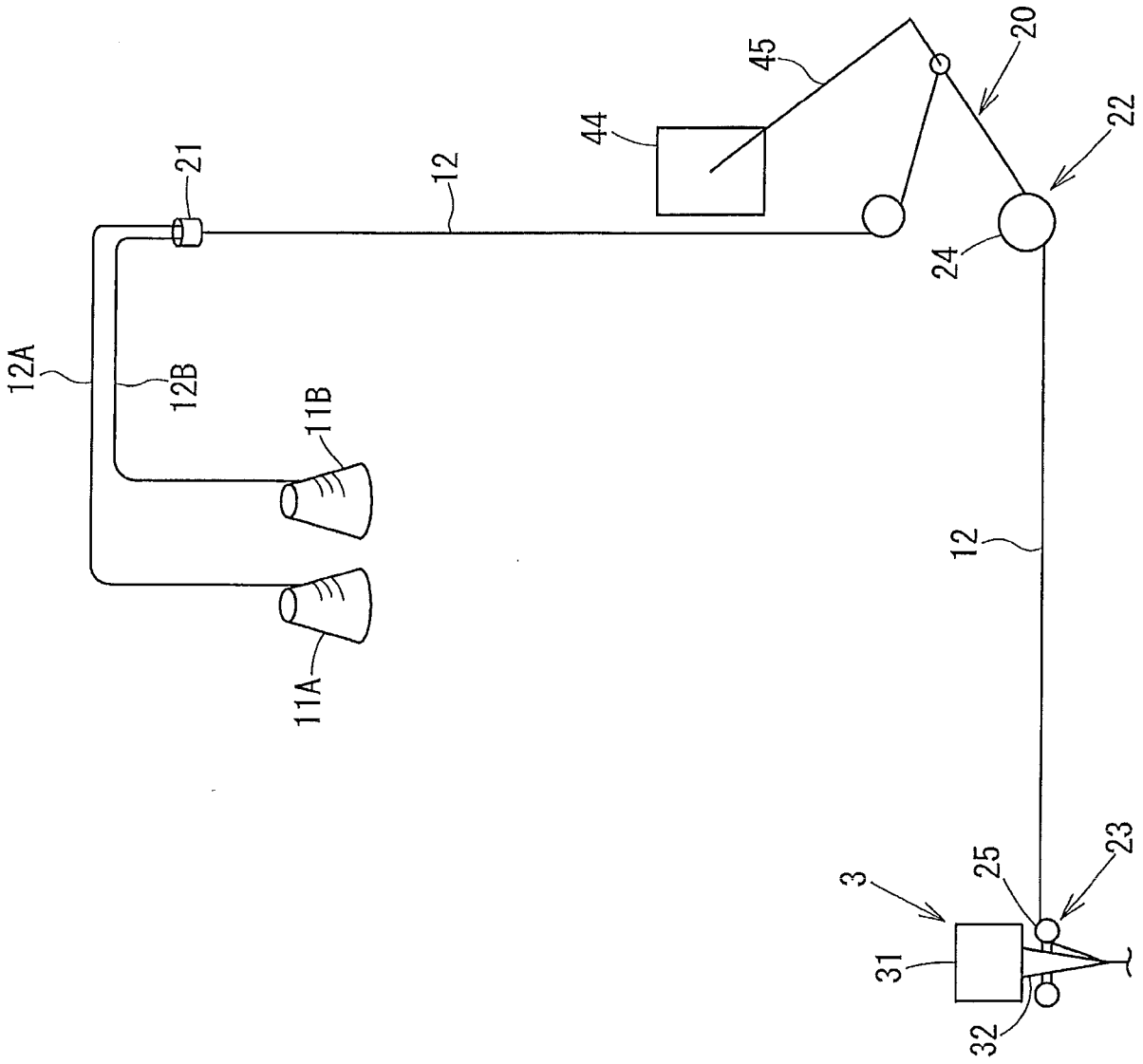

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 9468

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 202 144 544 U (RENHUI CHEN; PEIYING CHEN; BOLIN CHEN) 15 February 2012 (2012-02-15)	1	INV. D04B15/38 D04B15/54
A	* paragraphs [0002], [0013]; figures 4-7 *	2-6	

A	GB 1 402 752 A (LIR SPA LAB ITALIANO RICERCHE) 13 August 1975 (1975-08-13) * page 1, line 80 - page 2, line 31; figure 15 *	2	

A	JP H04 11057 A (GUNZE KK) 16 January 1992 (1992-01-16) * figure 1 *	1-6	

A	EP 1 939 340 A1 (PRECISION FUKUHARA WORKS LTD [JP]) 2 July 2008 (2008-07-02) * paragraph [0020]; figure 2 *	4	

A	EP 2 557 212 A1 (PAI LUNG MACHINERY MILL CO LTD [TW]) 13 February 2013 (2013-02-13) * figures 1, 2 *	1-6	TECHNICAL FIELDS SEARCHED (IPC) D04B

A	JP H10 212071 A (NITTA KK) 11 August 1998 (1998-08-11) * figure 3 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 August 2016	Kirner, Katharina

CATEGORY OF CITED DOCUMENTS

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31-08-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 202144544 U	15-02-2012	NONE	
GB 1402752 A	13-08-1975	CA 962047 A	04-02-1975
		DD 99346 A5	05-08-1973
		DE 2211209 A1	14-09-1972
		ES 400219 A1	01-01-1975
		FR 2141026 A5	19-01-1973
		GB 1402752 A	13-08-1975
		US 3774829 A	27-11-1973
JP H0411057 A	16-01-1992	NONE	
EP 1939340 A1	02-07-2008	CN 201040793 Y	26-03-2008
		EP 1939340 A1	02-07-2008
EP 2557212 A1	13-02-2013	NONE	
JP H10212071 A	11-08-1998	NONE	

EPO FORM P0459

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Patent documents cited in the description

- JP 2010144301 A **[0004]**