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(11)

EP 1 734 161 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.12.2006 Bulletin 2006/51

(51) Int Cl.:
D01H 5/72 (2006.01)

(21) Application number: **06114782.3**

(22) Date of filing: **31.05.2006**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**
Designated Extension States:
AL BA HR MK YU

(30) Priority: **02.06.2005 JP 2005162202**
23.03.2006 JP 2006080670

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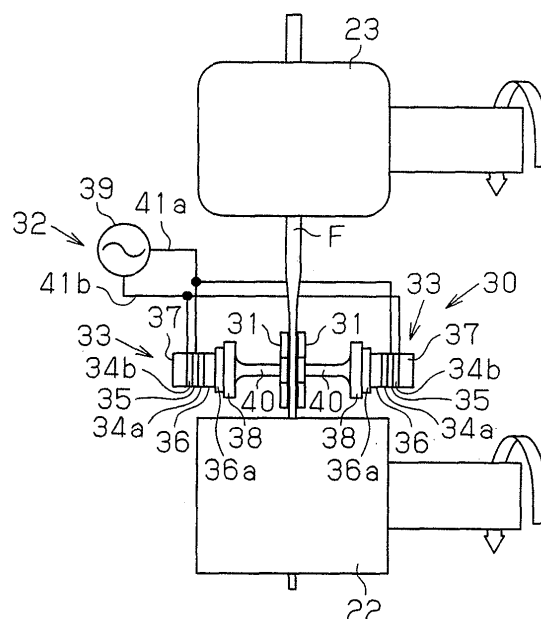
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(54) **Fiber bundle guiding device in spinning machine, and draft machine of spinning frame**

(57) A fiber bundle guiding device (30) is located between a middle bottom roller (13) and a back bottom roller (14). The guiding device (30) guides a fiber bundle (F) moving from an upstream side to a downstream side such that the width of the fiber bundle (F) is reduced. The guiding device (30) includes guiding members (31) and an oscillation portion (32). Each guiding member (31) has a guiding surface (31a) that extends along the moving direction of the fiber bundle (F) to be guided. The oscillation portion (32) vibrates the guiding members (31) to generate a sound pressure for preventing the fiber bundle (F) from contacting the guiding surfaces. Therefore, it is possible to guide a fiber bundle without contacting the fiber bundle, and to prevent deterioration over time of frictional state of the guiding surfaces due to abrasion and collection of foreign matter (Fig. 1B).

Fig.1B



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a fiber bundle guiding device in a spinning machine and to a draft machine of a spinning frame.

[0002] A typical spinning machine such as a spinning frame and a drawing frame has a guiding member for guiding a fiber bundle. When guiding a fiber bundle with guiding members, an area of the guiding member that contacts the fiber bundle is worn. Particularly, when the guiding member guides a fiber bundle that moves from an upstream side to a downstream side, thereby reducing the width of the fiber bundle, that is, when the guiding member causes the fiber bundle to concentrate, the friction between the contact area and the fiber bundle increases. This promotes the abrasion of the contact area.

[0003] Conventionally, for example, Japanese Examined Utility Model Publication No. 61-35568 discloses a collector for a spinning frame, which collector has an abrasion-resistant material piece is embedded and exposed in a portion receiving the greatest friction with fiber bundles. As shown in Fig. 15A, the publication proposes a draft machine 61 of a spinning frame that includes a collector 63 with an improved abrasion resistance. The collector 63 is located on an upper surface of a front bottom roller 62. As shown in Figs. 15B and 15C, the spinning frame collector 63 has a main body 64 made of plastic. A vertical squeezing groove 65 is formed in the main body 64. Abrasion-resistant members 66 formed of ceramic or stainless steel round rods made are embedded in both sides of a lower and narrowest portion of the groove 65. The abrasion-resistant members 66 have a predetermined length. The collector 63 is supported by a draft part 68, which functions as a tensor, with a wire 67.

[0004] In the collector 63, the abrasion-resistant members 66 are embedded so that their surfaces are exposed in sections receiving the greatest friction with a fiber bundles F. Thus, compared to a case where no abrasion-resistant members 66 are provided, the period between replacement of the collector 63 is extended. However, the abrasion-resistant members 66 are inevitably worn by friction with the fiber bundle F even at a gradual rate, and thus the performance deteriorates over time. The deterioration of the performance due to the contact friction becomes pronounced if in the spinning speed is increased or if synthetic fibers, which are stronger than cotton, are used as spun fibers.

[0005] Further, the guiding member disclosed in the above publication is not the only case where the friction of the surface needs to be reduced. That is, in order to guide a fiber bundle by contacting the fiber bundle, it is necessary to reduce the friction of the surface of the guiding member so that the fiber alignment in the fiber bundle is not disturbed. To reduce the friction of the surface of a guiding member, it is necessary to reduce the surface roughness through surface polishing, or plating and coat-

ing. However, although such measures guarantee a sufficient primary performance, the performance of the guiding member will deteriorate over time due to abrasion, damages, and collection of foreign matter on the surface.

[0006] Also, as for draft machines for spinning frames, there is a demand for spinning at a higher draft than conventionally obtained draft. However, if in a current draft machine the draft between back roller pair and middle roller pair is increased to achieve a desired level of draft, the width of the fiber bundle is increased in an area between the back roller and the middle roller, and the fiber bundle reaches the middle roller with the increased width. The drafting thus cannot be performed in a favorable manner. If a guiding member such as a trumpet is used for reducing the increased width of the fiber bundle before reaching the middle roller, the problems described above of abrasion of the guiding member will be pronounced.

SUMMARY OF THE INVENTION

[0007] Accordingly, it is an objective of the present invention to provide a fiber bundle guiding member in a spinning machine, which guiding member is capable of reducing the width of a fiber bundle without contacting the fiber bundle, maintaining the fiber alignment of the fiber bundle, and preventing deterioration over time of frictional state of a guiding surface due to abrasion and collection of foreign matter. Another objective of the present invention is to provide a draft machine of a spinning frame having such a fiber bundle guiding device.

[0008] To achieve the foregoing objectives, one aspect of the present invention provides a fiber bundle guiding device in a spinning machine. The guiding device guides a fiber bundle that moves from an upstream side to a downstream side such that a width of the fiber bundle is reduced. The guiding device includes a guiding member and an oscillation portion. The guiding member has a guiding surface that reduces the width of the fiber bundle along a moving direction of the fiber bundle to be guided. The oscillation portion causes the guiding member to vibrate to generate a sound pressure preventing the fiber bundle from contacting the guiding surface.

[0009] Another aspect of the present invention provides a draft machine installable in a spinning frame. The draft machine includes a back roller, a middle roller, and a first bundle guiding device. An apron is wound about the middle roller. The fiber bundle guiding device guides a fiber bundle that moves from an upstream side to a downstream side such that a width of the fiber bundle is reduced. The guiding device includes a guiding member and an oscillation portion. The guiding member has a guiding surface that reduces the width of the fiber bundle along a moving direction of the fiber bundle to be guided. The oscillation portion causes the guiding member to vibrate to generate a sound pressure preventing the fiber bundle from contacting the guiding surface. The fiber bundle guiding device is located between the back roller and the middle roller.

[0010] Yet another aspect of the present invention provides a draft machine installable in a spinning frame. The draft machine includes a final delivery roller, a roller immediately preceding the final delivery roller, and a fiber bundle guiding device. The guiding device guides a fiber bundle that moves from an upstream side to a downstream side such that a width of the fiber bundle is reduced. The guiding device includes a guiding member and an oscillation portion. The guiding member has a guiding surface that reduces the width of the fiber bundle along a moving direction of the fiber bundle to be guided. The oscillation portion causes the guiding member to vibrate to generate a sound pressure preventing the fiber bundle from contacting the guiding surface. The fiber bundle guiding device is located between the final delivery roller and the immediately preceding roller.

[0011] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1A is a side view illustrating a draft machine according to a first embodiment of the present invention;

Fig. 1B is a diagrammatic plan view illustrating the fiber bundle guiding device of Fig. 1A;

Fig. 2 is a diagrammatic perspective view illustrating the fiber guiding device of Fig. 1B;

Fig. 3 is a graph showing changes in torque of a drawing roller in the draft machine of Fig. 1A;

Fig. 4 is a graph showing changes in mass of a fiber bundle in the draft machine of Fig. 1A;

Fig. 5A is a partially enlarged view illustrating a draft machine according to a second embodiment of the present invention;

Fig. 5B is a diagram showing the relationship between a guiding member and a bottom roller, as viewed from above in Fig. 5A;

Fig. 6 is a side view illustrating the entire draft machine of Fig. 5A;

Fig. 7 is a graph showing the relationship between the number of short fuzzing fibers and the amplitude of the guiding member when the draft machine of Fig. 6 operates;

Fig. 8 is a graph showing the relationship between the number of long fuzzing fibers and the amplitude of the guiding member when the draft machine of Fig. 6 operates;

Fig. 9 is a graph showing the relationship between the number of short fuzzing fibers and the space between a pair of guiding surfaces when the draft machine of Fig. 6 operates;

Fig. 10 is a graph showing the relationship between the number of long fuzzing fibers and the space between a pair of guiding surfaces when the draft machine of Fig. 6 operates;

Fig. 11 is a diagrammatic perspective view illustrating a guiding member according to another embodiment;

Fig. 12 is a diagrammatic perspective view illustrating a guiding member according to yet another embodiment;

Fig. 13 is a diagrammatic perspective view illustrating a guiding member according to a further embodiment;

Fig. 14 is a diagrammatic perspective view illustrating a guiding member according to another embodiment;

Fig. 15A is a side view illustrating a draft machine having a prior art collector;

Fig. 15B is a diagrammatic perspective view illustrating the collector of Fig. 15A; and

Fig. 15C is a cross-sectional plan view illustrating the collector of Fig. 15A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] A draft machine 11 of a spinning frame according to a first embodiment of the present invention will now be described with reference to Figs. 1 to 4.

[0014] As shown in Fig. 1A, the draft machine 11 is a three-line type including a front bottom roller 12, a middle bottom roller 13, and a back bottom roller 14. The middle bottom roller 13 and the back bottom roller 14 are supported by a roller stand 15, which forms a base, with support brackets 16, 17, the positions of which are adjustable along forward and backward directions. The support brackets 16, 17 are fastened to predetermined positions with bolts 16a, 17a and nuts (not shown). The bolts 16a, 17a extend through elongated holes (not shown) formed in the roller stand 15. A bottom apron 13a is wrapped about a bottom tensor 19 and the middle bottom roller 13.

[0015] A front top roller 21, a middle top roller 22, and a back top roller 23 are supported by a weighting arm 20 with one of corresponding top roller support members. The front top roller 21, the middle top roller 22, and the back top roller 23 are located at positions each corresponding to the positions of the front bottom roller 12, the middle bottom roller 13, and the back bottom roller 14. A top apron 22a is wrapped about a tensor 24 and the middle top roller 22.

[0016] The weighting arm 20 has a lever 20a. The lever 20a is pivotable between a pressurizing position and a releasing position. When the lever 20a is at the pressu-

rizing position, the lever 20a contacts a frame 20b of the weighting arm 20 shown in Fig. 1A, and is locked at a pressurizing position (spinning position) where the lever 20a pushes the top rollers 21, 22, 23 supported by the weighting arm 20 toward the bottom rollers 12, 13, 14. When the lever 20a is pivoted upward to the releasing position from the state shown in Fig. 1A, the locked state is cancelled.

[0017] A fiber bundle guiding device 30 is located in the space between the back rollers (14, 23) and the middle rollers (13, 22), that is, the space between the back bottom roller 14 and the middle bottom roller 13. The guiding device 30 guides a fiber bundle F moving from an upstream side to a downstream side such that the width of the fiber bundle F is reduced.

[0018] As shown in Figs. 1B and 2, the guiding device 30 includes a pair of guiding members 31 and an oscillation portion 32. Each guiding member 31 has a guiding surface 31a (only shown in Fig. 2) that extends along the moving direction of the fiber bundle F to be guided. The oscillation portion 32 vibrates the guiding members 31 to generate a sound pressure for preventing the fiber bundle F from contacting the guiding surfaces 31a. The guiding members 31 are formed of a pair of flat plates arranged parallel to each other, and the guiding surfaces 31a are facing sides of the flat plates. The guiding surfaces 31a are wide and extend along the moving direction of the fiber bundle F. The entire guiding members 31 form a cross.

[0019] The oscillation portion 32 includes vibrators 33, which are Langevin transducers. Each vibrator 33 includes a pair of annular piezoelectric elements 34a, 34b. An annular electrode plate 35 is located between each pair of the piezoelectric elements 34a, 34b. Each vibrator 33 is formed by fixing metal blocks 36, 37 with bolts (not shown) to surfaces of the piezoelectric elements 34a, 34b opposite from the surfaces contacting the electrode plate 35. The bolt is screwed from the side of the metal block 37 into a threaded hole (not shown) formed in the metal block 36. The two metal blocks 36, 37 are electrically connected to each other by the bolt. A flange 36a is formed at a distal end of each metal block 36. The metal block 36 is fixed to an attaching piece 38 at the flange 36a. The vibrators 33 are each fixed to the support bracket 16 with a bolt (not shown) with the attaching piece 38 in between.

[0020] Each guiding member 31 is fixed to a horn 40, which is vibrated by the corresponding vibrator 33. Each horn 40 is formed by coupling a circular cylinder to a truncated cone tapered toward the distal end. Each horn 40 is fixed to a part of the corresponding guiding member 31 in the vicinity of one end through brazing. Each horn 40 is coupled to the corresponding vibrator 33 on a surface opposite to the surface to which the corresponding guiding member 31 is fixed. The distal surface of each horn 40 is formed as a flat surface perpendicular to the axial direction of the corresponding vibrator 33. The guiding members 31 are arranged such that a space between

the guiding surfaces 31a can be adjusted by changing the positions of the attaching pieces 38 with respect to the support brackets 16.

[0021] The vibrators 33 are connected to an oscillator 39. Each electrode plate 35 is connected to the oscillator 39 with a wire 41a. The ground terminal of the oscillator 39 is connected to the metal block 37 with a wire 41b. The vibrators 33, the horns 40, and the oscillator 39 form the oscillation portion 32 for vibrating the guiding members 31. The oscillator 39 causes the vibrators 33 to vibrate so that the guiding members 31 are vibrated at a frequency higher than the audible range of the human ear.

[0022] An operation of the draft machine 11 of the first embodiment, which is constructed as above, will hereafter be described.

[0023] Prior to an operation of the spinning frame, the positions of the middle bottom roller 13 and the back bottom roller 14 are adjusted by changing the positions of the support brackets 16, 17 in accordance with the type of raw material for spinning. The positions of the middle top roller 22 and the back top roller 23 are also adjusted in accordance with the positions of the middle bottom roller 13 and the back bottom roller 14. The space between the guiding members 31 is adjusted by changing the positions of the attaching pieces 38.

[0024] When the spinning frame is activated, the fiber bundle F is drafted by the draft machine 11 and is delivered from the front rollers (12, 21). After passing the nip points of the front bottom roller 12 and the front top roller 21, the fiber bundle F is moved downstream while being twisted. During the operation of the spinning frame, the oscillator 39 is activated to cause the vibrators 33 to vibrate the guiding members 31 at a predetermined frequency (for example, about 34 kHz), so that the horns 40 vibrate longitudinally. The vibration of the horns 40 vibrates the guiding members 31. Accordingly, the guiding surfaces 31a of the guiding members 31 emit sound waves (ultrasonic waves). The frequency of the vibration is determined such that the sound pressure of the sound waves emitted from the guiding surfaces 31a of the guiding members 31 has a magnitude for preventing the fiber bundle F from contacting the guiding surfaces 31a.

[0025] When moving from the upstream side to the downstream side of the draft machine 11, the fiber bundle F is guided in such a manner that its width is reduced by the guiding device 30. When the fiber bundle F passes through the space between the guiding surfaces 31a of the guiding members 31 before reaching the space between bottom apron 13a and the top apron 22a, the width of the fiber bundle F is reduced by the guiding members 31, for example, one quarter of the width at the upstream side.

[0026] When the guiding members 31 are not activated, the friction between the guiding surfaces 31a and the fiber bundle F is great. Thus, when the fiber bundle F passes between the guiding members 31, the fiber alignment of the fiber bundle F is disturbed, or the fiber bundle

F is cut. However, when the spinning frame is operating, the guiding members 31 are vibrated, and the sound pressure of the sound waves emitted from the guiding members 31 prevents the fiber bundle F from contacting the guiding surface 31a. As a result, even if the width of the fiber bundle F is significantly reduced from the width at the upstream side of the guiding members 31, the frictional force when passing through the space between the guiding surfaces 31a is reduced by a great amount.

[0027] In a conventional spinning frame, the draft is 1.1 to 1.3 in the back zone, and maximally 50 in the apron zone. The resultant draft is thus approximately 60 to 70. It has been desired to increase the draft to approximately 120. To satisfy the demand, the draft in the back zone may be increased more than double. However, if the draft in the back zone is increased more than double in a current draft machine, the fiber bundle F, after exiting the back rollers, reaches the aprons with a greater width compared to the case where the draft is 1.1 to 1.3. To perform drafting in a favorable manner, frictional force is needed between fibers. However, if the fiber bundle F reaches the aprons with an increased width, frictional force between the fibers is insufficient and the drafting cannot be performed in a favorable manner.

[0028] With the draft in the back zone doubled, the effect of the guiding device 30 was examined by activating the draft machine 11. It was confirmed that the guiding device 30 permitted drafting to be performed in a favorable manner even with the doubled draft in the back zone.

(Example)

[0029] The guiding members 31 were made by cutting a cold-rolled aluminum alloy plate having a thickness of 2 mm. The guiding device 30 was produced using Langevin transducers as the vibrators 33. The guiding device 30 was arranged such that a pair of the guiding members 31 were located between the middle rollers (13, 22) and the back rollers (14, 23). The space between the guiding members 31 was set to 0.75 mm. Tests were conducted by activating the draft machine 11 such that the width of the fiber bundle F sent from the back rollers (14, 23) to the middle rollers (13, 22) became 4 mm, and the draft in the back zone was 2.0. Since the speed of the back bottom roller 14 was 4 to 5 rpm, and the outer circumference of the back bottom roller 14 was 100 mm, the moving speed of the fiber bundle F was about 400 to 500 mm/min.

[0030] Figs. 3 and 4 show the results. Fig. 3 shows changes in the torque of a drawing roller (the middle bottom roller 13) in a case where the guiding members 31 were vibrated (ultrasonic waves generated) and a case where the guiding members 31 were not vibrated (ultrasonic waves not generated). Fig. 4 shows changes in the mass of the fiber bundle F (fleece) in a case where the guiding members 31 were vibrated and a case where the guiding members 31 were not vibrated. The vertical axis of Fig. 4 represents the output level of a detector corre-

sponding to the mass of the fiber bundle.

[0031] As obvious from Fig. 3, the torque of the drawing roller was significantly reduced when ultrasonic waves were produced compared to when ultrasonic waves were not produced. This corroborates that, when ultrasonic waves are not produced, resistance (friction) applied to the fiber bundle F when passing through the guiding members 31 is great, and that, when ultrasonic waves are produced, the resistance applied to the fiber bundle F when passing through the guiding members 31 is reduced. The torque of the drawing roller when ultrasonic waves were produced is substantially equal to the torque of a case where no guiding members for reducing the width of a fiber bundle are located between the middle bottom roller 13 (drawing roller) and the back bottom roller 14. This corroborates that, even if the space between the guiding surfaces 31a is extremely narrow in relation to the width of the fiber bundle F at the upstream side, the sound pressure emitted from the guiding surfaces 31a permits the fiber bundle F to pass through the space between the guiding surfaces 31a without contacting the guiding surfaces 31a.

[0032] Also, as obvious from Fig. 4, the mass of the fiber bundle F fluctuated in a narrow range about the output level corresponding to the draft of 2.0 in the back zone when ultrasonic waves were produced. That is, the drafting was performed accurately. On the other hand, when ultrasonic waves were not produced, the mass of the fiber bundle F fluctuated greatly. That is, the drafting was not performed sufficiently. In a guiding method in which the fiber bundle F contacted the guiding surfaces 31a, and the fiber bundle F received compression force, the mass was significantly reduced in a part of the fiber bundle F where fibers became scarce due to unevenness of the fiber bundle F. This increased the fluctuation in the mass of the fiber bundle F per unit length. This further corroborates that when ultrasonic waves are produced, the sound pressure emitted from the guiding surfaces 31a permits the fiber bundle F to pass through the space between the guiding surfaces 31a without contacting the guiding surfaces 31a.

[0033] This embodiment provides the following advantages.

- (1) The guiding device 30 includes the guiding members 31 and the oscillation portion 32. Each guiding member 31 has the guiding surface 31a that, when the guiding members 31 are attached to a spinning machine, extends along the moving direction of the fiber bundle F to be guided. The oscillation portion 32 vibrates the guiding members 31 to generate sound waves of a sound pressure for preventing the fiber bundle F from contacting the guiding surface 31a. Therefore, the fiber bundle F can be guided in a low friction state while preventing the friction state of the guiding surfaces 31a deteriorate over time due to abrasion of the guiding surfaces 31a caused by friction with the fiber bundle F and collected foreign

matter. Also, since the guiding surfaces 31a extend along the moving direction of the fiber bundle F, the fiber bundle F enters the space between the bottom apron 13a and the top apron 22a after moving along the guiding surfaces 31a in a state compressed along the width. Thus, for example, unlike a case where the guiding surfaces are arcuate and a section in which the space between the guiding surfaces is narrow is significantly short along the moving direction of the fiber bundle F, the fiber bundle F enters the space between the bottom apron 13a and the top apron 22a while the width of the fiber bundle F is reduced to a desired size.

(2) The guiding members 31 are formed of a pair of flat plates arranged parallel to each other, and the guiding surfaces 31a are the facing sides of the flat plates. Therefore, the distance between the guiding surfaces 31a, which face each other, can be changed by changing the space between the flat plates. Thus, in correspondence with the spinning conditions such as the size of the spun yarn, the space between the guiding surfaces 31a is easily adjusted.

(3) In the draft machine 11, the guiding device 30 is located between the back rollers (14, 23) and the middle rollers (13, 22). Therefore, when the resultant draft is set to about 120 by increasing the draft in the back zone, the draft in the apron zone does not need to be changed. Specifically, the desired draft can be achieved by approximately doubling the draft in the back zone.

(4) Since the guiding members 31 are vibrated at frequencies higher than the audible range of the human ear, the vibration type guiding device 30 does not produce noise of vibration.

A second embodiment of the present invention will now be described with reference to Figs. 5A to 10. The second embodiment is basically the same as the first embodiment except for that a final delivery roller pair is provided in a downstream end of the moving direction of a fiber bundle of a three-line draft section, and that the guiding device 30 is located between the final delivery roller pair and an immediately preceding roller pair. Thus, like or same reference numerals are given to those components that are like or same as the corresponding components of the first embodiment and detailed explanations are omitted.

As shown in Fig. 6, the draft machine 11 is a four-line type including a final delivery roller pair 26 located downstream of the three-line type draft section in the moving direction of fiber bundles. The three-line type draft section includes a front bottom roller 12, a middle bottom roller 13, a bottom apron 13a, a back bottom roller 14, a front top roller 21, a middle top

roller 22, a top apron 22a, a back top roller 23, and a tensor 24.

The final delivery roller pair 26 includes a bottom nip roller 26a supported by the roller stand 15, and a top nip roller 26b supported by the weighting arm 20 with a support member. Like the front top roller 21 of the draft machine 11, the top nip roller 26b is supported by the weighting arm 20 for every other spindle.

The guiding device 30 is located between the final delivery roller pair 26 and an immediately preceding roller pair including the front bottom roller 12 and the front top roller 21. "Immediately preceding rollers" refer to rollers, which are the front bottom roller 12 and the front top roller 21, located immediately upstream of the final delivery rollers in the moving direction of fiber bundles.

Guiding members 31 are formed of a pair of plates facing each other, and guiding surfaces 31a are the facing sides of the plates. As shown in Fig. 5B, the pair of plates are arranged such that the space between the facing sides, that is, the space between the guiding surfaces 31a, is wider in an upstream side than in a downstream side in the moving direction of the fiber bundle F. Specifically, the guiding members 31 are formed such that the space increases toward the upstream end in a section upstream of the center of the guiding surfaces 31a, and that the space is constant in a section downstream of the center. Hence, a state in which "the space is wider in an upstream side than in a downstream side" includes not only a case where the space gradually widens from the downstream end to the upstream end, but also a case where the space is constant partway from the downstream and then gradually increases toward the upstream end.

As shown in Figs. 6 and 5A, the guiding members 31 are shaped like crosses as viewed from a side and each have a guiding section 31b extending to a nip section of the bottom nip roller 26a and the top nip roller 26b, which form the final delivery roller pair. The guiding sections 31b are formed such that the width is reduced toward the downstream end in the moving direction of the fiber bundle F. That is, the guiding members 31 of the second embodiment are different from the guiding members 31 of the first embodiment in that, instead of a pair of flat plates, a pair of plates having a curved section are used, and that the width of the guiding sections 31b is reduced toward the distal ends.

An oscillation portion 32 of the second embodiment for vibrating the guiding members 31 are the same as that of the first embodiment. Vibrators 33 are each fixed to a roller stand 15 with a bolt (not shown) with an attaching piece 38 in between.

An operation of the draft machine 11 of the second embodiment, which is constructed as above, will hereafter be described.

Prior to an operation of the spinning frame, the po-

sitions of the middle bottom roller 13 and the back bottom roller 14 are adjusted by changing the positions of the support brackets 16, 17 in accordance with the type of raw material for spinning. The positions of the middle top roller 22 and the back top roller 23 are also adjusted in accordance with the positions of the middle bottom roller 13 and the back bottom roller 14. The space between the guiding members 31 is adjusted by changing the positions of the attaching pieces 38. Although depending on the spinning conditions, the space between the downstream ends of the guiding surfaces 31a is set no more than 1 mm.

When the spinning frame is activated, the fiber bundle F is drafted by the three-line type draft section of the draft machine 11, and then guided to the nip section of the final delivery roller pair 26 via the guiding surfaces 31a of the guiding members 31. The fiber bundle F is subsequently delivered through the final delivery roller pair 26. During the operation of the spinning frame, the oscillator 39 is activated to cause the vibrators 33 to vibrate the guiding members 31 at a predetermined frequency (for example, about 34 kHz), so that the horns 40 vibrate longitudinally. The vibration of the horns 40 vibrates the guiding members 31. After passing through the nip point of the bottom nip roller 26a and the top nip roller 26b, the fiber bundle F moves downstream while being twisted, and is then wound about a bobbin (not shown). The final delivery roller pair 26 is rotated at a surface velocity slightly faster than the surface velocity of the front bottom roller 12 and the front top roller 21, so that the fiber bundle F passes through the nip point of the final delivery roller pair 26 while kept in an appropriate tension. Then, after its direction is changed, the fiber bundle F moves downstream while being twisted.

The fiber bundle F, which has been drafted by the three-line type draft section, is compressed so that the thickness is equal to or less than 1 mm while passing the guiding surface 31a. The fiber bundle F is guided to the final delivery roller pair 26 and passes the nip point. Therefore, compared to a spinning frame equipped with a three-line type draft machine having no guiding device 30, the second embodiment suppresses fuzzing and waste cotton, and thus improves the yarn quality.

For example, an apparatus has been proposed and put to practical use as an spinning frame for suppressing fuzzing and waste cotton, in which spinning frame a fiber bundle F drafted by a three-line type draft machine is concentrated by a fiber bundle concentrating device using suction, and delivered to the downstream side by a nip roller pair. The fiber bundle concentrating device includes a final delivery roller pair of a draft part, a suction part having a guiding surface, and a perforated belt (mesh belt). The guiding surface has a suction hole located between the

final delivery roller pair and the nip roller pair located downstream of the final delivery roller pair. The perforated belt is rotated while sliding on the guiding surface.

In a configuration for concentrating a fiber bundle F using suction, air suction is performed for all the spindles. This increases the power consumption. To obtain spun yarn of a stable quality, maintenance needs to be performed. For example, cotton fly collected on the perforated belt needs to be periodically removed, and the belt needs to be replaced when worn out. Such maintenance requires a considerable number of steps since the concentrating mechanism has a complicated structure.

However, the guiding device 30 of the second embodiment compresses and guides the fiber bundle F while the guiding surfaces 31a of the guiding members 31 emit sound pressure of the sound waves having a magnitude for preventing the fiber bundle F from contacting the guiding surfaces 31a. Therefore, compared to a configuration for concentrating a fiber bundle using suction, the second embodiment consumes less electricity, and requires no maintenance for periodically removing cotton fly from the guiding member 31 and replacement.

Also, for example, in a configuration that uses suction to concentrate the fiber bundle F, even if the suction force is adjusted, the feeling (touch) of the spun yarn cannot be controlled. Such a configuration is only capable of switching between spinning of yarn (compact yarn) having little fuzzing, which is obtained through spinning using the fiber bundle concentrating device, and spinning of normal yarn, which is obtained through spinning without the fiber bundle concentrating device.

However, in the guiding device 30 of the second embodiment, the feeling of the spun yarn can be adjusted by changing the conditions in which the guiding members 31 are vibrated. Experiments were carried out in which middle count cotton yarn (cotton comb: 40 count) was obtained while changing the amplitude of the vibration plates, which is one of the vibration conditions of the guiding members 31, that is, the amplitude of the guiding surfaces 31a. Specifically, the numbers of long fuzzing fibers (6 mm) and short fuzzing fibers (1 mm) per 100 m of the spun yarn were counted. The spinning frame was operated with the speed of the spindles set at 20000 rpm, and the surface velocity of the final delivery roller pair 26 set at 20 m/min. Figs. 7 and 8 each show the results. In Figs. 7 and 8, the amplitude is shown in relative values in respect to a reference value being 100%.

Further, experiments were carried out in which middle count cotton yarn (cotton comb: 40 count) was obtained while changing the space between the vibration plates, which is one of the vibration conditions of the guiding members 31, that is, the space

between the guiding surfaces 31a. Specifically, the numbers of long fuzzing fibers (6 mm) and short fuzzing fibers (1 mm) per 100 m of the spun yarn were counted. Figs. 9 and 10 each show the results. In Figs. 9 and 10, the space is shown in relative values in respect to a reference value being 100%.

Long fuzzing fibers (length of 6 mm) are impeditive in a weaving process, and short fuzzing fibers (length of 1 mm) affect the feeling.

As shown in Fig. 7, when the guiding members 31 were vibrated at a reference amplitude, the number of short fuzzing fibers was equal to or less than that of a compact yarn obtained by the fiber bundle concentrating device that concentrates a fiber bundle F using suction (shown by dotted line in Fig 7, approximately 7400). However, when the amplitude of the guiding members 31 was reduced by 25% or 50%, the number of the fuzzing fibers were increased to 9200, which is greater than that in the case of the reference amplitude. A normal yarn that is spun by a conventional spinning frame without the guiding device 30 has a number of short fuzzing fibers approximately 12400.

On the other hand, the number of long fuzzing fibers was approximately thirty and was scarcely changed when the amplitude of the guiding members 31 was changed as shown in Fig. 8. A normal yarn that is spun by a conventional spinning frame without the guiding device 30 has a number of long fuzzing fibers approximately 330. This corroborates that, as shown in Figs. 7 and 8, when the guiding device 30, which compresses and guides the fiber bundle F using sound pressure of vibrations of the guiding members 31, is used, changes in the amplitude allow the feeling of the spun yarn to be adjusted almost without increasing the long fuzzing fibers, which are impeditive to the weaving process.

As shown in Fig. 9, when the guiding members 31 were vibrated with a space in between, the number of short fuzzing fibers was equal to or less than that of a compact yarn obtained by the fiber bundle concentrating device that concentrates a fiber bundle F using suction (shown by dotted line in Fig 9, approximately 7400). However, when the space between the guiding members 31 was changed from the reference space, the number of fuzzing fibers changed. For example, when the space between the guiding members 31 was increased from the reference space by 25%, the number of short fuzzing fibers was slightly increased to approximately 7600. When the space was increased from the reference space by 50%, the number of short fuzzing fibers was increased to approximately 9500. When the space was increased from the reference space by 75%, the number of short fuzzing fibers was increased to approximately 10200.

On the other hand, the number of long fuzzing fibers was approximately forty and was scarcely changed

when the space between the guiding members 31 was changed as shown in Fig. 10. This corroborates that, as shown in Figs. 9 and 10, when the guiding device 30, which compresses and guides the fiber bundle F using sound pressure of vibrations of the guiding members 31, is used, changes in the space between the guiding members 31 allow the feeling of the spun yarn to be adjusted almost without increasing the long fuzzing fibers, which are impeditive to the weaving process.

The surface velocity of the final delivery roller pair 26 may be the same as the surface velocities of the immediately preceding roller pair, or the front bottom roller 12 and the front top roller 21. However, depending on the type of the yarn, the relative surface velocity of the final delivery roller pair 26 is preferably greater so that the spun yarn quality is improved. For example, in a case of a material of short fiber lengths (for example, when the average fiber length is about 28 mm), the relative surface velocity of the final delivery roller pair 26 is preferably slightly increased. The second embodiment has the following advantages in addition to the advantage (4) of the first embodiment.

(5) The guiding device 30 includes the final delivery roller pair 26, the guiding members 31, and the oscillation portion 32. Each guiding member 31 has the guiding surface 31a that is located between the front bottom roller 12 and the front top roller 21, and extends along the moving direction of the fiber bundle F to be guided. The oscillation portion 32 vibrates the guiding members 31 to generate sound waves of a sound pressure for preventing the fiber bundle F from contacting the guiding surfaces 31a. Therefore, the fiber bundle F can be guided in a compressed state to the space between the bottom nip roller 26a and the top nip roller 26b, which form the final delivery roller pair 26, in a low friction state while preventing the friction state of the guiding surfaces 31a from deteriorating over time due to abrasion of the guiding surfaces 31a caused by friction with the fiber bundle F and collected foreign matter. Thus, the width of the fiber bundle F can be reduced before the fiber bundle F is guided to and reaches the final delivery roller pair 26. When delivered from the final delivery roller pair 26, the fiber bundle F has been twisted in a concentrated state. Thus, unevenness and fuzzing fibers are reduced. This increases the tenacity of the yarn. Since the fiber bundle F is moved without contacting the guiding surfaces 31a, the fiber bundle F is guided while its width is more reduced compared to a case where guiding members that contact and guide the fiber bundle F are used. Also, by adjusting the amplitude of the guiding surfaces 31a, the feeling of spun product (spun yarn) can be controlled.

(6) The guiding members 31 are formed of a pair of

plates facing each other, and the guiding surfaces 31a are the facing sides of the plates. Therefore, the distance between the guiding surfaces 31a, which face each other, can be changed by changing the space between the plates. Thus, in correspondence with the spinning conditions such as the size of the spun yarn, the space between the guiding surfaces 31a is easily adjusted. Also, by adjusting the space between the guiding surfaces 31a, the feeling of the spun product (spun yarn) can be controlled.

(7) The pair of plates forming the guiding members 31 are arranged such that the space between the facing sides, forming the guiding surfaces 31a, is wider in an upstream side than in a downstream side in the moving direction of the fiber bundle F. Therefore, even if the space between the guiding surfaces 31a is narrow, the fiber bundle F is easily guided to the space between the guiding surface 31a.

(8) The guiding members 31 of the guiding device 30 have the guiding sections 31b extending toward the final delivery roller pair 26. Therefore, the fiber bundle F is smoothly guided to the nip section of the final delivery roller pair 26.

(9) The guiding device 30 guides and compresses the fiber bundle F using the sound pressure of vibrations of the guiding members 31, which are vibration plates. Thus, unlike a configuration that concentrates the fiber bundle F using suction, the guiding device 30 has a simpler structure. Therefore, the guiding device 30 itself can be driven simultaneously with a traverse mechanism of the fiber bundle F, which extends the polishing cycle of rubber rollers in the draft machine 11.

[0034] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the invention may be embodied in the following forms.

[0035] Instead of the configuration in which the parallel plates, or the guiding members 31, are each vibrated by one of the separate vibrators 33, a configuration may be employed in which a single flat plate is bent at both sides to have a channel-like cross-section, such that parallel guiding surfaces facing each other are formed. The guiding member is vibrated by a single vibrator. In this case, the space between the guiding surfaces cannot be adjusted in accordance with the width (size) of the fiber bundle F, which is the spinning material. Thus, when the spinning material is changed to a greatly different spinning material, the guiding members need to be replaced.

[0036] The guiding members are not limited to a pair of flat plates arranged parallel to each other. For example, in accordance with the intended use, the guiding member may be formed as a hollow tube having a shape of, for

example, a truncated cone, a truncated pyramid, or a truncated elliptic cone. The cross-sectional shape is reduced from the upstream side to the downstream side in the moving direction of the fiber bundle F. In this case, the guiding surface is formed by the inner surface of the tube. The guiding member may be formed as a hollow tube having a constant cross-sectional shape. If vibration is generated by a piezoelectric member (piezoelectric elements), a plurality of modes can be added. Thus, even if the guiding member has a tubular structure, the guiding member is effectively vibrated by overlapping piezoelectric member on the guiding member such that the element generates longitudinal vibration and lateral vibration.

[0037] As long as desired frequencies and amplitudes are obtained, the excitation portion is not limited to Langevin transducers. Further, without providing horns, piezoelectric member (piezoelectric elements) may be directly attached to the guiding member. For example, in a case where the guiding member is formed as a tubular member, a piezoelectric member 42 is attached to a circumference of a guiding member 50 having a guiding surface 50a as shown in Fig. 11.

[0038] The excitation portion may be formed by a magnetostrictor or a super magnetostrictor instead of the vibrators 33, which are formed by piezoelectric members.

[0039] The vibration frequency of the guiding members 31 is set to a frequency of high vibration efficiency in consideration of the material, shape, and size of the guiding members 31, and the size of the guided fiber bundle F. The frequency is preferably equal to or higher than 15 KHz in view of reduction of noise. However, even if the frequency is in the audible range, the noise is low compared to other noises during the operation of the spinning machine. The frequency may thus be in the audible range.

[0040] It may be configured that a plurality of guiding members 31 are provided in a single vibration system, and a single excitation portion, that is, a vibrator and an oscillator 39 is provided.

[0041] It may be configured that a plurality of vibrators provided on a plurality of spindles of a spinning frame, or piezoelectric member directly attached to a plurality of the guiding member 31 are excited by a single oscillator 39.

[0042] In the first embodiment, the guiding members 31 do not need to be located between the middle rollers (13, 22) and the back rollers (14, 23). For example, the guiding members 31 may be located between the front rollers (12, 21) and the middle rollers (13, 22). Alternatively, the guiding members 31 may be located between the front rollers (12, 21) and the middle rollers (13, 22), and between the middle rollers (13, 22) and the back rollers (14, 23).

[0043] The bottom apron 13a and the top apron 22a are not indispensable. That is, the present invention may be applied to a draft machine having no aprons.

[0044] The first embodiment may be applied to a four-line type draft machine.

[0045] The guiding device 30 may be used in any apparatus other than spinning frames as long as such a spinning machine requires a guiding device for guiding a fiber bundle F to reduce the fiber bundle F that moves from an upstream side to a downstream side. For example, the guiding device 30 may be used in a drawing frame or a comber. In the case of a drawing frame, the present invention is not limited to draft machines. Specifically, the present invention may be applied to a guiding device 30 that concentrates and guides a fiber bundle F in a non-contact manner instead of a gatherer or a trumpet, which make a sliver by concentrating a fiber bundle F extended by a draft machine.

[0046] In a case where the guiding device 30 is used as a gatherer of a drawing frame or comber, the guiding member may be configured as shown in Fig. 12. Specifically, the guiding member includes a bottom wall 51b and side walls 51c, which define guiding surfaces 51a, and the entire guiding member 51 is vibrated by a single vibrator 33.

[0047] In the second embodiment, as long as the fiber bundle F can be compressed and guided with a low frictional resistance by means of the sound pressure of the vibration, the space between the facing surfaces of the pair of plates do not need to be configured such that the space increases from the downstream side to the upstream side. For example, the guiding members 31 may be formed of a pair of curved plates or a pair of flat plates, such that the space between the facing guiding surfaces 31a is gradually reduced in the entire guiding surfaces 31a from the upstream side to the downstream side in the moving direction of the fiber bundle F. The guiding members 31 of the guiding device 30 may be configured such that the guiding surfaces 31a, which are the facing surfaces of flat plates, are parallel to each other.

[0048] The guiding members 31 of the guiding device 30 are not limited to the configurations in which the guiding surfaces 31a are formed by flat plates or curved plates. For example, a guiding member 52 as shown in Fig. 13 may be used. The guiding member 52 has a cross-sectional shape that is reduced from an upstream side to a downstream side in the moving direction of a fiber bundle. The guiding member 52 has a groove 53, which functions as a slit, extending along the longitudinal direction of the guiding member 52. A guiding surface 52a is formed on the inner surface. The groove 53 is not limited to a linear groove extending along the longitudinal direction of the guiding member 52, but may be curved or meandering. The guiding member 52 is not limited to the configuration in which the groove 53 opens upward, but may be configured that the groove 53 has a lateral opening or a downward opening. For example, compared to the case where a guiding member is formed by a pair of plates having facing guiding surfaces, in the case where a tubular guiding member 52 has a groove 53, the size and the number of the guiding device 30 are reduced, which reduces the costs of the guiding device 30. Since the guiding member has the groove 53, it is easy to in-

troduce the fiber bundle F into the guiding member 52.

[0049] The guiding device 30 may have a guiding member 55 as shown in Fig. 14. The guiding member 55 has a single plate 56 on which grooves 57 are formed at intervals corresponding to the pitch of the spindles. This simplifies the structure, and fiber bundles F of a plurality of spindles can be guided by the single guiding member 31. This reduces the costs for manufacturing the guiding device 30.

[0050] The configuration for guiding the fiber bundle F, which has been compressed by the guiding device 30, to the nip section of the final delivery rollers of the draft machine 11 is not limited to the configuration of the second embodiment, in which the guiding members 31 are located between the pair of the front bottom roller 12 and the front top roller 21 of the three-line type draft section and the final delivery roller pair 26. For example, it may be configured that the bottom roller of the final delivery roller pair is replaced by a large roller, so that the bottom roller functions as a front bottom roller of a three-line draft section, and the guiding members 31, 52 are located above the bottom roller.

[0051] As a configuration for guiding the fiber bundle F, which has been compressed by the guiding device 30, to the nip section of the final delivery rollers of the draft machine 11, the guiding members 31 may be located between the final delivery roller pair of the three-line draft machine 11, or the pair of the front bottom roller 12 and the front top roller 21, and the immediately preceding roller pair, or the pair of the middle bottom roller 13 and the middle top roller 22.

[0052] In the second embodiment, the guiding device 30 is located between the final delivery roller pair 26 and the pair of the front bottom roller 12 and the front top roller 21. In such a draft machine, the guiding device 30 may be located between the pair of the back rollers (14, 23) and the pair of the middle rollers (13, 22) as in the first embodiment.

[0053] A fiber bundle guiding device (30) is located between a middle bottom roller (13) and a back bottom roller (14). The guiding device (30) guides a fiber bundle (F) moving from an upstream side to a downstream side such that the width of the fiber bundle (F) is reduced. The guiding device (30) includes guiding members (31) and an oscillation portion (32). Each guiding member (31) has a guiding surface (31a) that extends along the moving direction of the fiber bundle (F) to be guided. The oscillation portion (32) vibrates the guiding members (31) to generate a sound pressure for preventing the fiber bundle (F) from contacting the guiding surfaces. Therefore, it is possible to guide a fiber bundle without contacting the fiber bundle, and to prevent deterioration over time of frictional state of the guiding surfaces due to abrasion and collection of foreign matter (Fig. 1B).

Claims

1. A fiber bundle guiding device (30) in a spinning machine, the guiding device (30) guiding a fiber bundle (F) that moves from an upstream side to a downstream side such that a width of the fiber bundle (F) is reduced, the guiding device **characterized by:**
 - a guiding member (31, 50, 51, 52, 55) having a guiding surface (31a, 50a, 51a, 52a) that reduces the width of the fiber bundle (F) along a moving direction of the fiber bundle (F) to be guided; and
 - an oscillation portion (32) that causes the guiding member (31) to vibrate to generate a sound pressure preventing the fiber bundle (F) from contacting the guiding surface (31a).
2. The fiber bundle guiding device (30) according to claim 1,
characterized in that the guiding member (31) includes a pair of flat plates (31) that face each other, and wherein the flat plates (31) include facing surfaces that are arranged parallel to each other and each form the guiding surface (31a).
3. The fiber bundle guiding device (30) according to claim 1,
characterized in that the guiding member (31) includes a pair of plates (31) that face each other, wherein the plates (31) include facing surfaces (31a), a space between the facing surfaces (31a) being greater in the upstream side than in the downstream side in the moving direction of the fiber bundle (F), and wherein the facing surfaces each form the guiding surface (31a).
4. The fiber bundle guiding device (30) according to claim 1,
characterized in that the guiding member (50, 52) includes a tubular body (50, 52) the cross-section of which is reduced from the upstream side toward the downstream side in the moving direction of the fiber bundle (F), and wherein an inner surface of the tubular body (50, 52) forms the guiding surface (50a, 52a).
5. The fiber bundle guiding device (30) according to claim 4,
characterized in that the tubular body (52) has a groove (53) that is formed continuously from one end of the tubular body (52) to the other end.
6. A draft machine (11) installable in a spinning frame, the draft machine (11) comprising:
 - a back roller (14); and
 - a middle roller (13) about which an apron (13a)

is wound, the draft machine (11) being **characterized by:**

- the fiber bundle guiding device (30) according to any one of claims 1 to 5, wherein the fiber bundle guiding device (30) is located between the back roller (14) and the middle roller (13).
7. The draft machine (11) according to claim 6,
characterized in that the oscillation portion (32) is driven by an oscillator (39), which is common to a plurality of spindles.
8. A ring-spinning frame **characterized by** the draft machine (11) according to claim 6.
9. A draft machine (11) installable in a spinning frame, the draft machine (11) comprising:
 - a final delivery roller (26a); and
 - a roller (12) immediately preceding the final delivery roller (26a),
 the draft machine (11) **characterized by:**
 - the fiber bundle guiding device (30) according to any one of claims 1 to 5, wherein the fiber bundle guiding device (30) is located between the final delivery roller (26a) and the immediately preceding roller (12).
10. The draft machine (11) according to claim 9,
characterized in that the guiding member (31) includes a guiding sections (31b) extending toward a nip section of the final delivery roller (26a).
11. The draft machine (11) according to claim 9,
characterized in that the oscillation portion (32) is driven by an oscillator (39), which is common to a plurality of spindles.
12. A ring-spinning frame **characterized by** the draft machine (11) according to claim 9.

Fig.1A

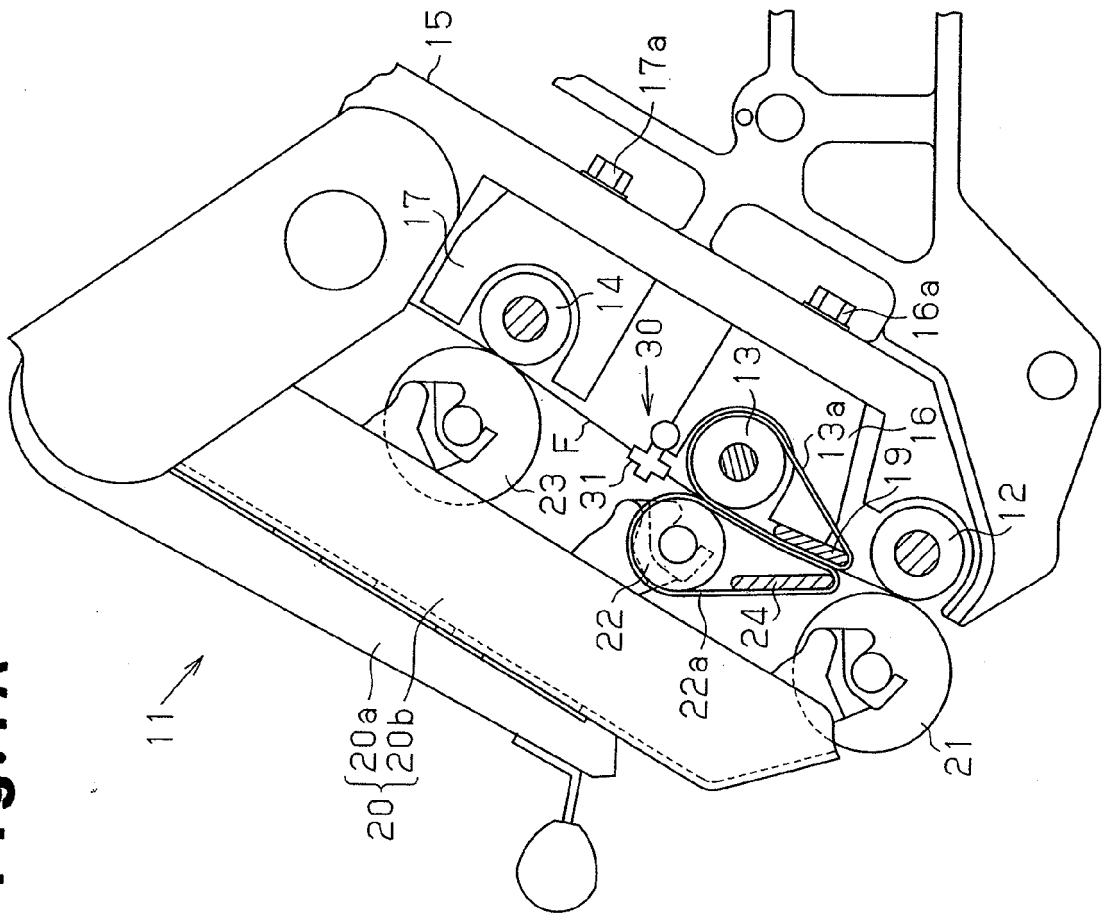


Fig.1B

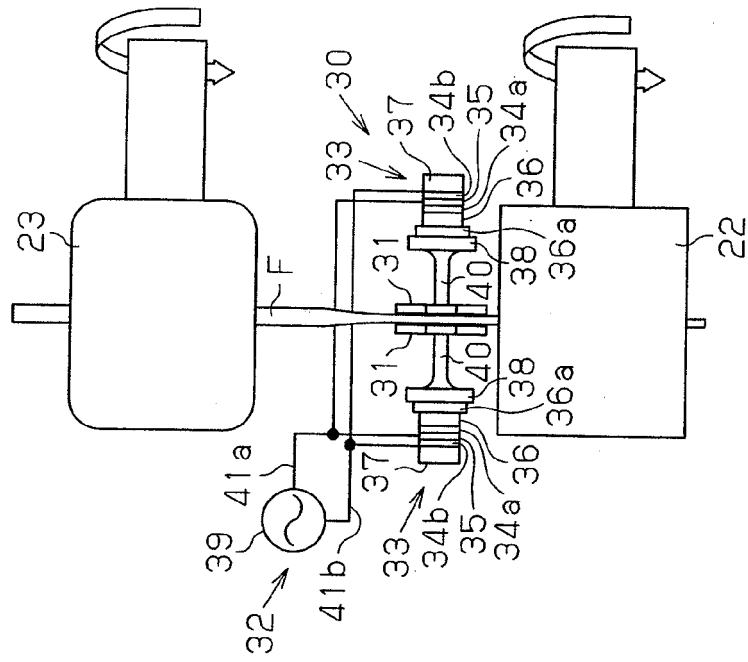


Fig.2

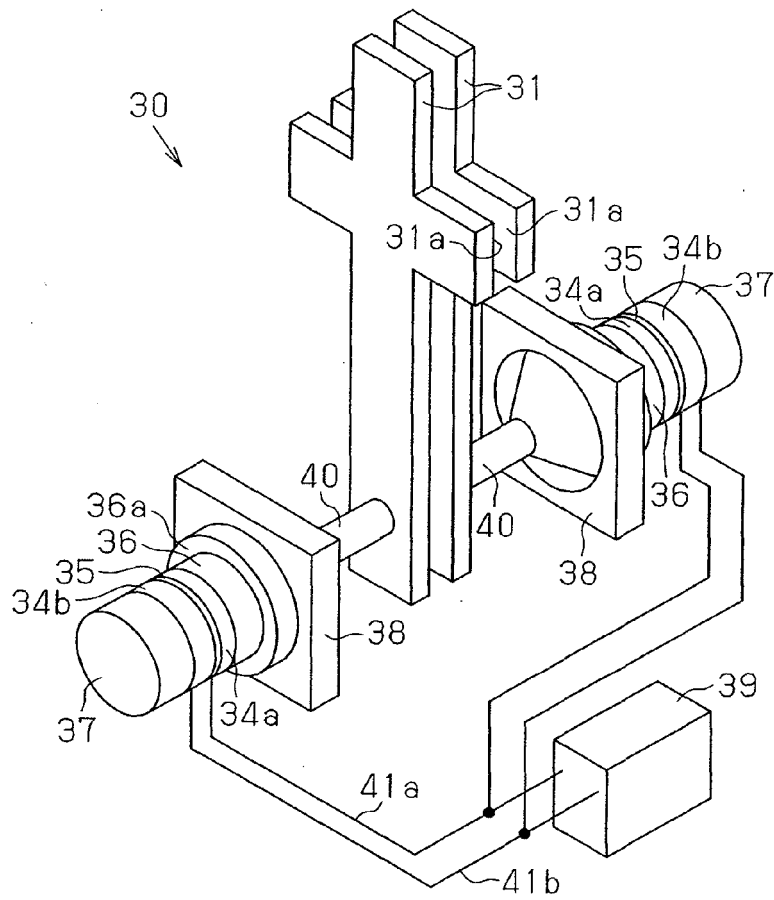


Fig.3

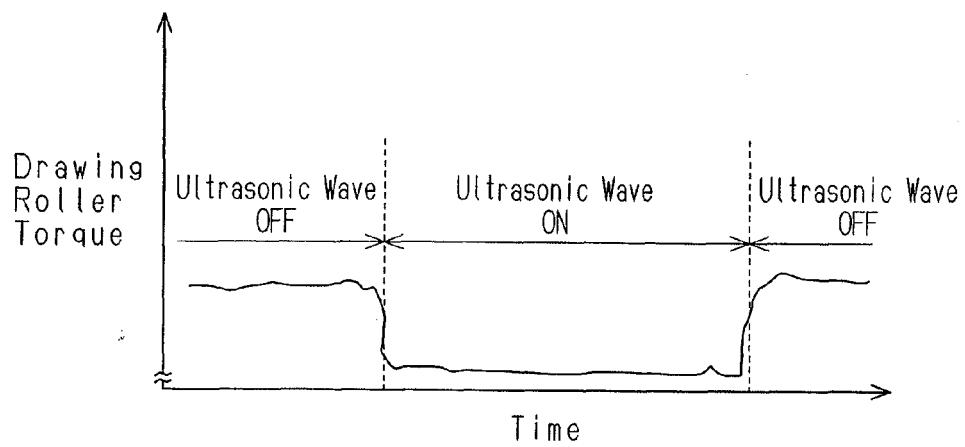


Fig.4

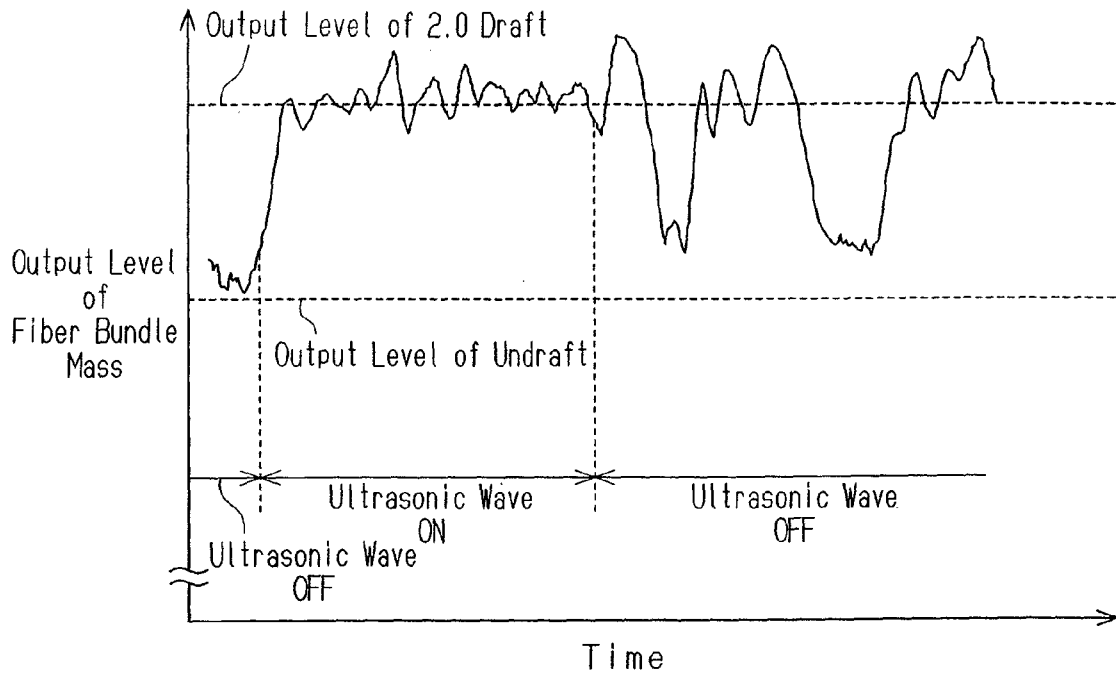


Fig.5A

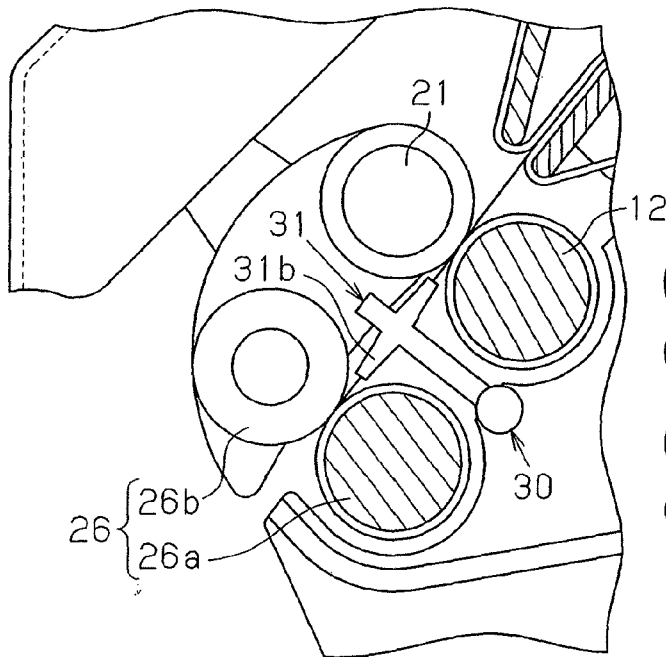


Fig.5B

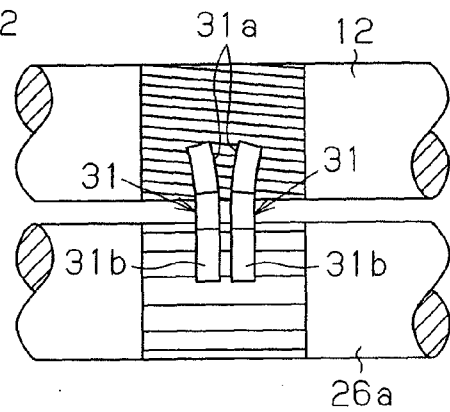


Fig.6

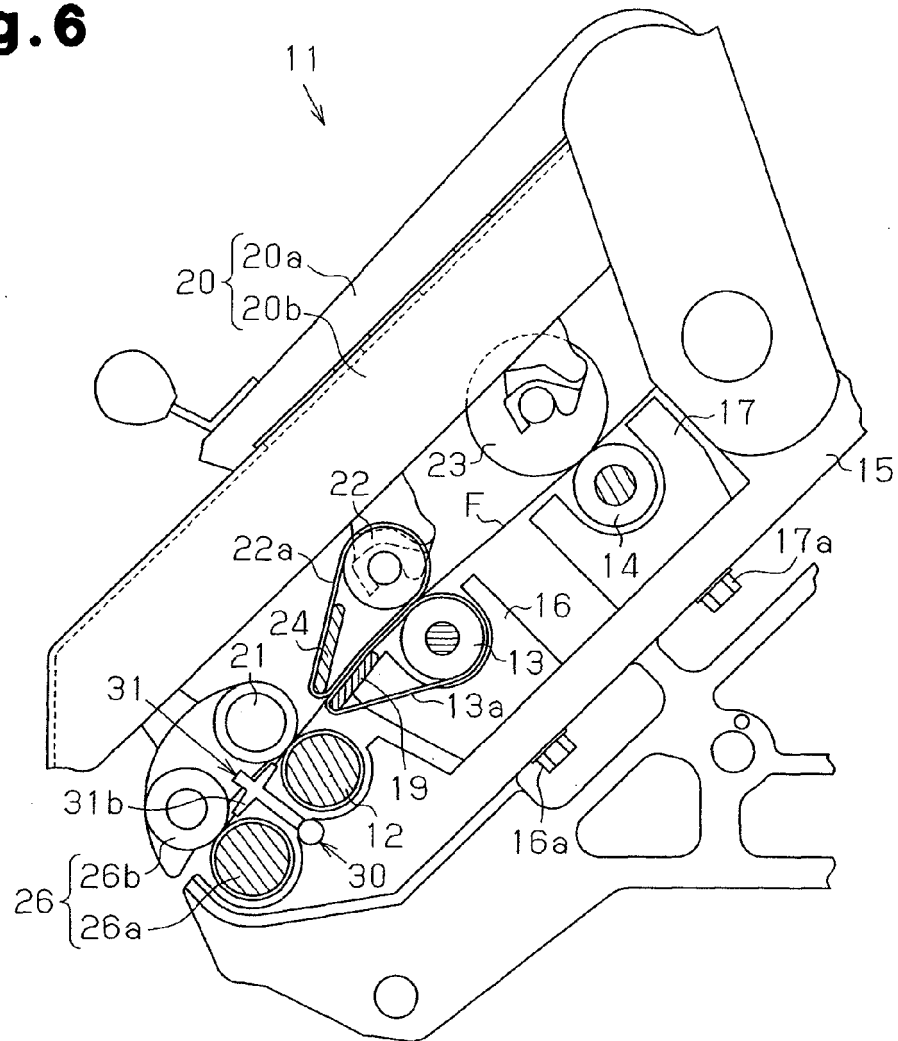


Fig.7

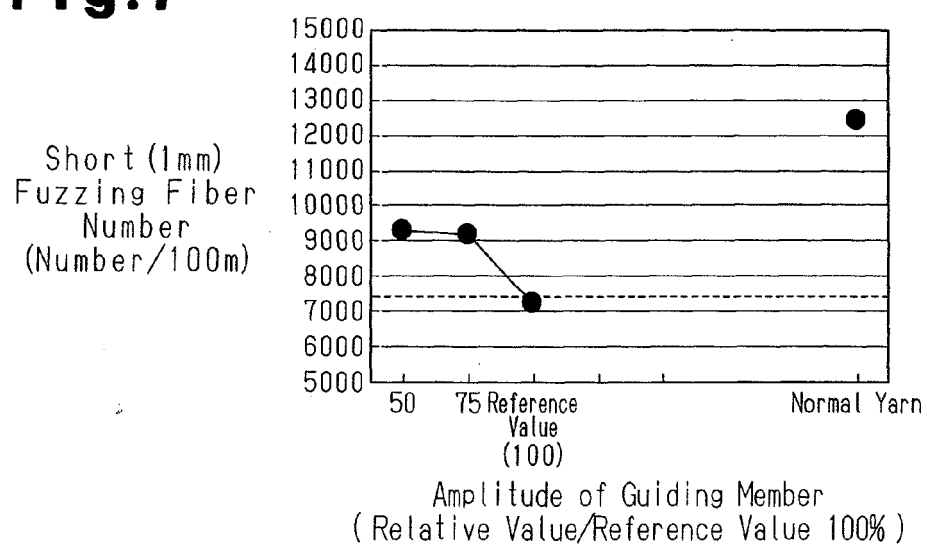


Fig.8

Long (6mm)
Fuzzing Fiber
Number
(Number/100m)

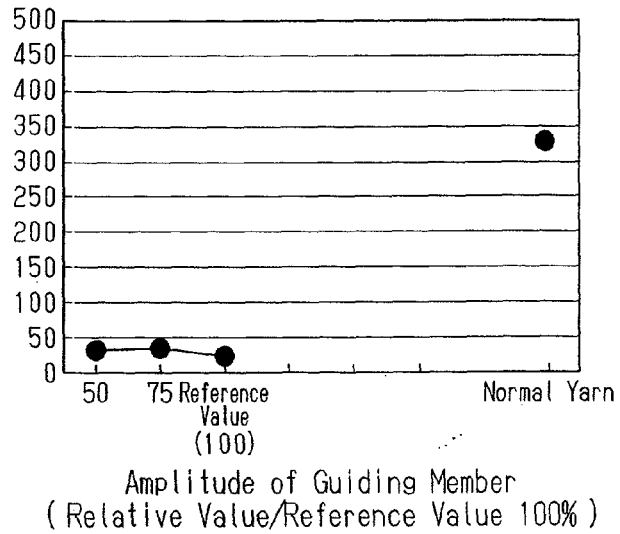


Fig.9

Short (1mm)
Fuzzing Fiber
Number
(Number/100m)

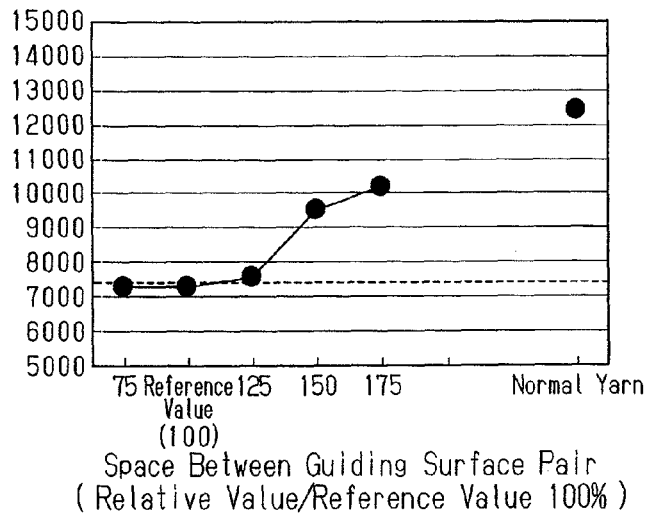


Fig.10

Long (6mm)
Fuzzing Fiber
Number
(Number/100m)

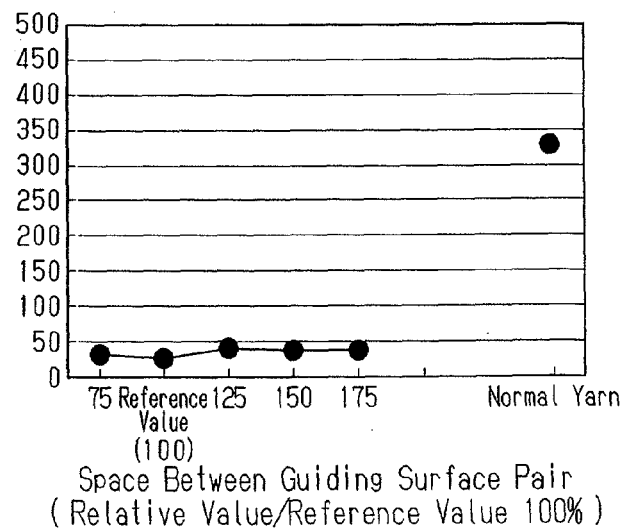


Fig.11

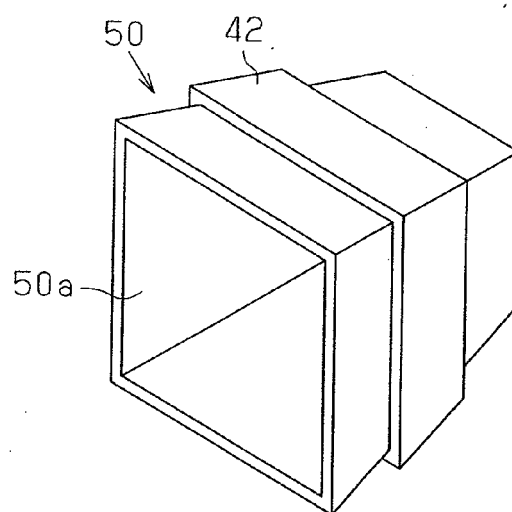


Fig.12

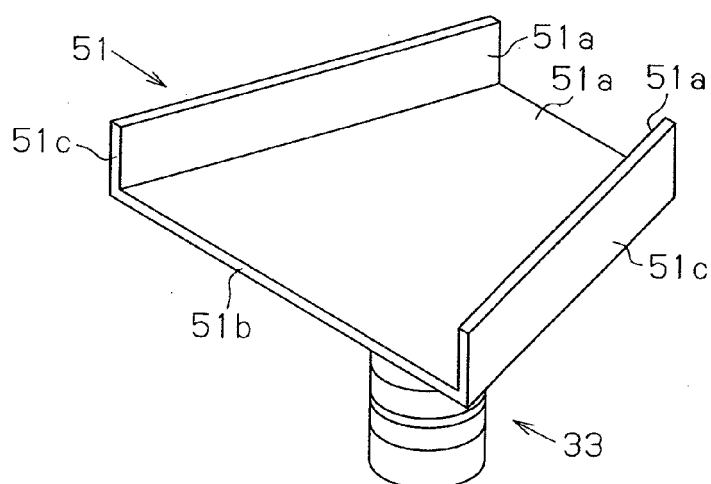


Fig.13

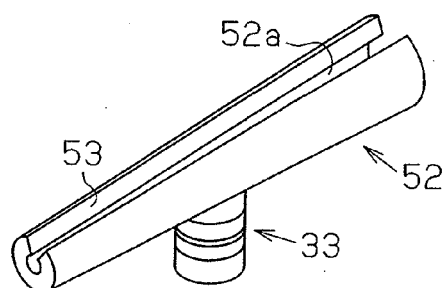


Fig.14

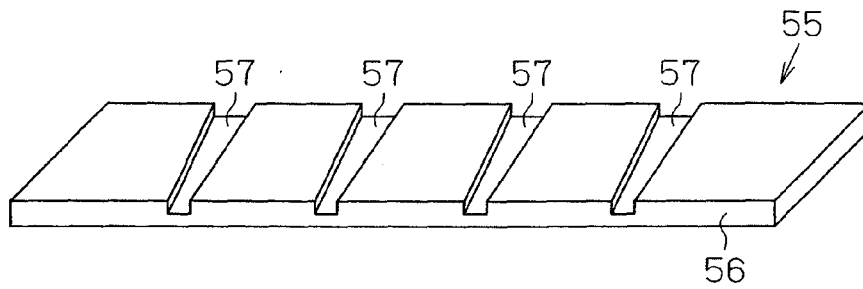


Fig.15A

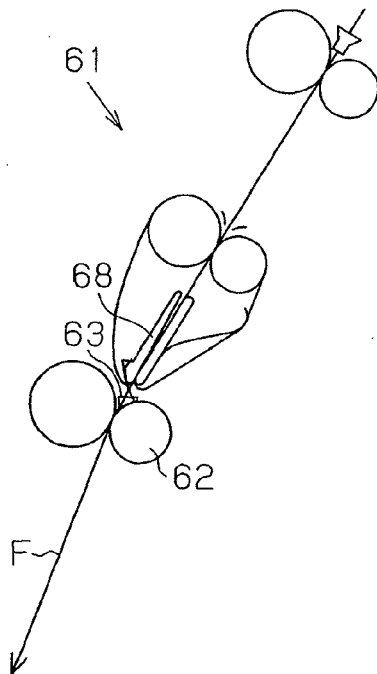


Fig.15B

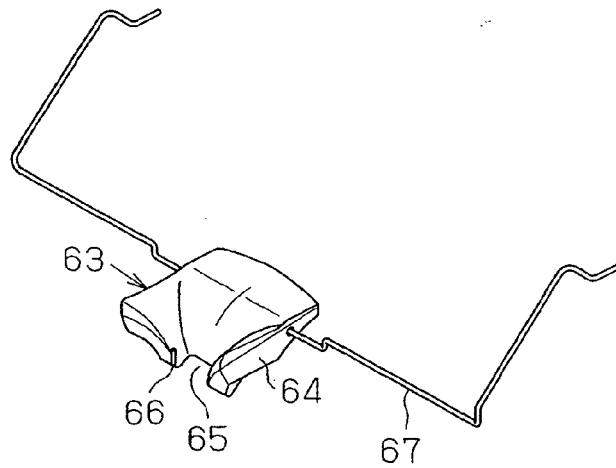
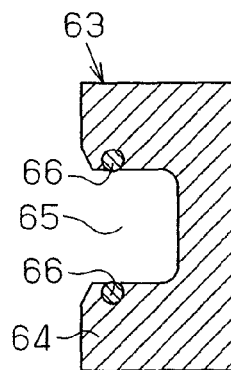


Fig.15C



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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