



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
24.10.2012 Bulletin 2012/43

(51) Int Cl.:
C23C 14/56 (2006.01) **B65H 9/16** (2006.01)
B65H 23/025 (2006.01) **B65H 23/038** (2006.01)
C23C 16/44 (2006.01)

(21) Application number: **10837410.9**

(22) Date of filing: **22.11.2010**

(86) International application number:
PCT/JP2010/070787

(87) International publication number:
WO 2011/074381 (23.06.2011 Gazette 2011/25)

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

- **YOKOYAMA, Shoji**
Kawasaki-shi
Kanagawa 210-0856 (JP)
- **YAMADA, Takanori**
Kawasaki-shi
Kanagawa 210-0856 (JP)

(30) Priority: **14.12.2009 JP 2009282865**

(71) Applicant: **Fuji Electric Co., Ltd.**
Kawasaki-shi, Kanagawa 210-0856 (JP)

(74) Representative: **Appelt, Christian W.**
Boehmert & Boehmert
Pettenkoferstrasse 20-22
80336 München (DE)

(72) Inventors:
• **NISHIZAWA, Masanori**
Kawasaki-shi
Kanagawa 210-0856 (JP)

(54) **CONVEYANCE DEVICE FOR FILM SUBSTRATE**

(57) The present invention provides a film substrate conveying device that is capable of adjusting, with a high degree of accuracy, the position of each of substrates conveyed in both a forward feed direction and a backward feed direction. The film substrate conveying device is a device for conveying a belt-like film substrate 2 while placing the film substrate 2 upright, with one end part thereof being on an upper side in a width direction thereof, this film substrate conveying device having: at least a pair of first grip rollers 6 that is disposed so as to sandwich an upper end part of the film substrate 2 therebetween; and a first angle adjusting mechanism 11 that is capable of adjusting an inclination direction and an inclination angle of the first grip rollers 6 so as to be able to incline a rotation angle of the first grip rollers 6 such that a rotation direction of the first grip rollers 6 is on an upper side with respect to a conveying direction.

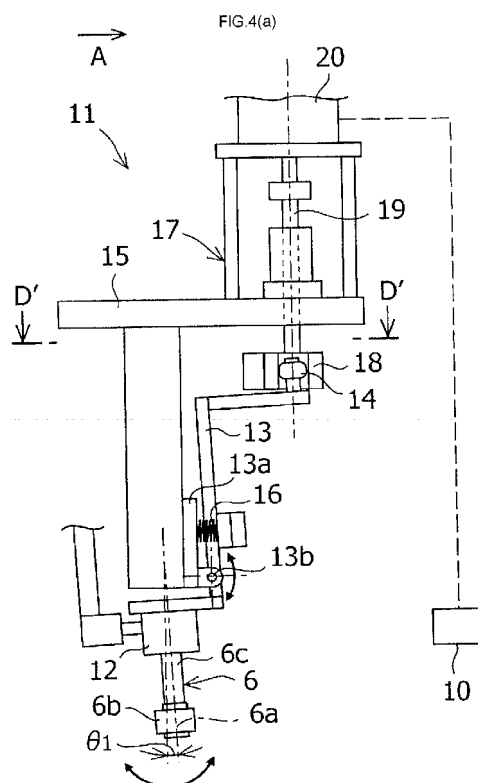
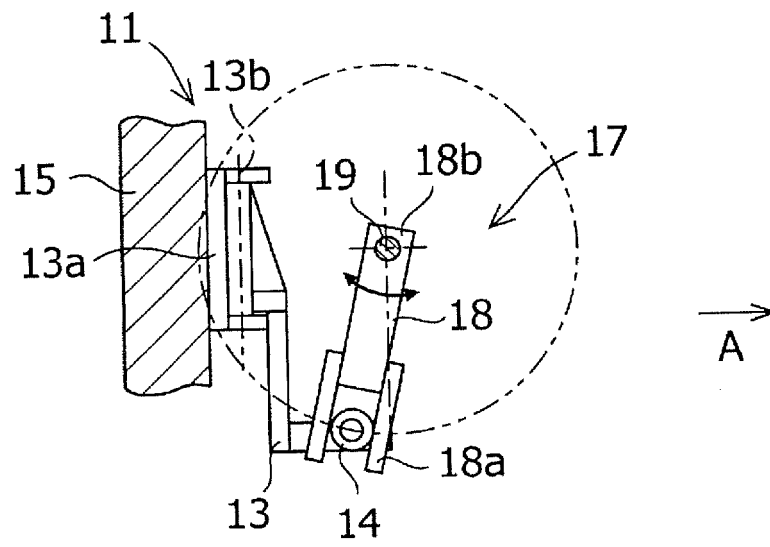


FIG. 4(b)



Description

TECHNICAL FIELD

[0001] The present invention relates to a film substrate conveying device for conveying a film substrate (referred to as "substrate" hereinafter) while placing the film substrate upright, with one end part thereof being on an upper side with respect to a width direction thereof.

BACKGROUND ART

[0002] A device for manufacturing a thin-film laminated body (referred to as "manufacturing device" hereinafter) is used for forming, on a surface of a substrate, a photoelectric conversion layer composed of a thin-film photoelectric conversion element. This manufacturing device is configured to hermetically form the substrate within a film-forming chamber thereof. Furthermore, in order to convey the substrate into the film-forming chamber, the substrate wound by an unwinding core is dispatched toward the film-forming chamber, passes through the film-forming chamber, and then wound by a winding core.

[0003] As a substrate conveying method of a film substrate conveying device (referred to as "conveying device" hereinafter) provided mainly in the above-described manufacturing device, an upright conveying method is adopted where a substrate is conveyed while being placed upright, with one end part thereof being on upper side with respect to a width direction thereof. A conveying device using this upright conveying method is excellent in terms of preventing contamination of the substrate because particles cannot accumulate on the surface of the substrate, and in terms of reducing the space of the manufacturing device by placing the substrate upright. Meanwhile, the substrate is pulled and held mainly between the unwinding core and winding core. Therefore, the substrate tends to be weighed down and might meander in the width direction. In such a case, the position of the substrate is displaced in the width direction, causing warpage of the substrate in the width direction. Stress is concentrated unevenly in the substrate due to this warpage, causing wrinkles on the substrate. Due to the wrinkles, the characteristics of the thin-film photoelectric conversion element and the like formed on the substrate deteriorate.

[0004] For this reason, the structure disclosed in Patent Document 1 is adopted in which grip rollers for adjusting the position of a substrate in a width direction are provided in a conveying device for conveying the substrate in a forward feed direction. In this manufacturing device, the plurality of pairs of grip rollers are provided in a manner as to sandwich an upper end part and a lower end part of the substrate. The pair of grip rollers holding the upper end part is tilted upward with respect to the forward feed direction of the substrate, whereas the pair of grip rollers holding the lower end part is tilted downward with respect to the forward feed direction of

the substrate.

[0005] An outer circumferential surface of each pair of grip rollers is provided with an elastic body for protecting the substrate. However, when the elastic body wears out and becomes weak, the gripping force acting between each grip roller and the substrate becomes low, and, consequently, adequate lifting force for lifting up the substrate cannot be obtained. For this reason, Patent Document 1 is designed to enhance the gripping force of the pairs of grip rollers by increasing the force of the grip rollers sandwiching the substrate therebetween (referred to as "substrate sandwiching force" hereinafter), in order to deal with the deterioration of the elastic body.

[0006] Patent Document 1: Japanese Patent Application Publication No. 2009-38276

[0007] However, in Patent Document 1, the grip rollers holding the upper end part are tilted upward only with respect to the forward feed direction of the substrate, whereas the grip rollers holding the lower end part are tilted downward only with respect to the forward feed direction of the substrate. Thus, when the substrate is conveyed in both the forward feed direction and a backward feed direction, these grip rollers can accurately adjust the position of the substrate conveyed in the forward feed direction but cannot adjust the position of the substrate conveyed in the backward feed direction.

[0008] Moreover, in Patent Document 1, when increasing the substrate sandwiching force of the grip rollers that is obtained by the elastic body on the outer circumferential surface, the elastic body on the outer circumferential surface might be squashed, changing the shape of the cross-section of the outer circumferential surface into an ellipse, as well as the diameter of the grip rollers. In such a case, a desired gripping force and adequate lifting force for lifting up the substrate cannot be obtained, which makes it difficult to move the substrate to a desired position. This leads to a decrease of the accuracy of adjusting the position of the substrate.

DISCLOSURE OF THE INVENTION

[0009] The present invention was contrived in view of the circumstances described above, and an object thereof is to provide a film substrate conveying device capable of adjusting, with a high degree of accuracy, the position of each of substrates conveyed in both a forward feed direction and a backward feed direction.

[0010] In order to achieve the object described above, a film substrate conveying device of the present invention is a film substrate conveying device for conveying a belt-like film substrate while placing the film substrate upright, with one end part thereof being on an upper side in a width direction thereof, this film substrate conveying device having: at least a pair of first grip rollers that is disposed so as to sandwich an upper end part of the film substrate therebetween; and a first angle adjusting mechanism that is capable of adjusting an inclination direction and an inclination angle of the first grip rollers so

as to be able to incline a rotation axis angle of the first grip rollers such that a rotation direction of the first grip rollers is on an upper side with respect to a conveying direction.

[0011] The film substrate conveying device according to the present invention further has: at least a pair of second grip rollers that is disposed so as to sandwich a lower end part of the film substrate therebetween; and a second angle adjusting mechanism that is capable of adjusting an inclination direction and an inclination angle of the second grip rollers so as to be able to incline a rotation axis angle of the second grip rollers such that a rotation direction of the second grip rollers is on a lower side with respect to the conveying direction.

[0012] The film substrate conveying device according to the present invention further has detection means for detecting a level of a width direction end part of the film substrate, wherein when the detection means detects a displacement of the film substrate, the first angle adjusting mechanism and/or the second angle adjusting mechanism performs control to incline the first grip rollers and/or the second grip rollers in an inclination direction corresponding to the conveying direction of the film substrate.

[0013] In the film substrate conveying device according to the present invention, the first angle adjusting mechanism and/or the second angle adjusting mechanism performs control to change the inclination angle of the first grip rollers and/or the second grip rollers in order to correct the displacement of the substrate.

[0014] The film substrate conveying device of the present invention can accomplish the following effects. The film substrate conveying device according to the present invention is a film substrate conveying device for conveying a belt-like film substrate while placing the film substrate upright, with one end part thereof being on an upper side in a width direction thereof and conveying the film substrate, the film substrate conveying device having: at least a pair of first grip rollers that is disposed so as to sandwich an upper end part of the film substrate therebetween; and a first angle adjusting mechanism that is capable of adjusting an inclination direction and an inclination angle of the first grip rollers so as to be able to incline a rotation axis angle of the first grip rollers such that a rotation direction of the first grip rollers is on an upper side with respect to a conveying direction.

The film substrate conveying device further has: at least a pair of second grip rollers that is disposed so as to sandwich a lower end part of the film substrate therebetween; and a second angle adjusting mechanism that is capable of adjusting an inclination direction and an inclination angle of the second grip rollers, so as to be able to incline a rotation axis angle of the second grip rollers such that a rotation direction of the second grip rollers is on a lower side with respect to the conveying direction.

The film substrate conveying device further has detection means for detecting a level of a width direction end part of the film substrate, wherein when the detection means

detects a displacement of the film substrate, the first angle adjusting mechanism and/or the second angle adjusting mechanism performs control to incline the first grip rollers and/or the second grip rollers in the inclination direction corresponding to the conveying direction of the film substrate.

In this manner, the position of the film substrate conveyed in the forward feed direction and the backward feed direction can be adjusted with a high degree of accuracy.

[0015] In the film substrate conveying device according to the present invention, the first angle adjusting mechanism and/or the second angle adjusting mechanism performs control to change the inclination angle of the first grip rollers and/or the second grip rollers in order to correct the displacement of the substrate. For instance, when the gripping force of the first grip rollers weakens due to the wear of the first grip rollers, and adequate lifting force for lifting the film substrate cannot be obtained, the position of the film substrate can be corrected by increasing the inclination of the first grip rollers and the distance in which the film substrate moves in the width direction. As a result, imposing an excess load onto the film substrate can be inhibited without increasing the force of the first grip rollers sandwiching the film substrate. On the other hand, when the gripping force of the first grip rollers fluctuates and therefore becomes so high that the lifting force for lifting up the film substrate becomes excessively strong, the position of the film substrate can be corrected by reducing the inclination of the first grip rollers and the distance in which the film substrate moves in the width direction. As a result, the accuracy of adjusting the position of the film substrate can be prevented from dropping.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a cross-sectional plan view schematically showing a device for manufacturing a thin-film laminated body according to a first embodiment of the present invention;

Fig. 2(a) is a cross-sectional plan view schematically showing an enlarged view of a film-forming chamber of Fig. 1, and Fig. 2(b) is a cross-sectional diagram taken along a line C-C shown in Fig. 2(a);

Fig. 3(a) is a schematic front view showing an angle adjusting mechanism used when a rotation axis of a grip roller is placed along a width direction of a film substrate, according to the first embodiment of the present invention, Fig. 3(b) is a schematic side view of the angle adjusting mechanism shown in Fig. 3 (a), and Fig. 3(c) is a cross-sectional diagram taken along a line D-D shown in Fig. 3(a);

Fig. 4(a) is a schematic front view showing the angle adjusting mechanism that inclines the grip roller to adjust the position of the substrate conveyed in a forward feed direction, according to the first embod-

iment of the present invention, and Fig. 4(b) is a cross-sectional diagram taken along a line D'-D' shown in Fig. 4(a);

Fig. 5 is a schematic enlarged front view showing the grip roller of Fig. 4(a);

Fig. 6(a) is a schematic front view showing an angle adjusting mechanism that inclines the grip roller to adjust the position of the substrate conveyed in a backward feed direction, according to the first embodiment of the present invention, and Fig. 6(b) is a cross-sectional diagram taken along a line D"-D" shown in Fig. 6(a);

Fig. 7 is a schematic enlarged front view showing the grip roller of Fig. 6(a);

Fig. 8 is a cross-sectional diagram taken along the line C-C shown in n Fig. 2(a), according to a second embodiment of the present invention; and

Fig. 9 is a graph showing a relationship between an inclination angle of the grip roller and a lifting force of the grip roller for lifting up the film substrate.

BEST MODE FOR CARRYING OUT THE INVENTION

[First Embodiment]

[0017] A film substrate conveying device according to a first embodiment of the present invention is described hereinafter.

As shown in Fig. 1, in a device for manufacturing a thin-film laminated body (referred to as "manufacturing device" hereinafter) 1 that includes a film substrate conveying device (referred to as "conveying device" hereinafter), a belt-like film substrate (referred to as "substrate" hereinafter) 2 is placed upright with one end part thereof being on an upper side in a width direction thereof, and then conveyed. A thin film is then formed on a surface of the substrate 2. The first embodiment illustrates a situation in which the width direction of the substrate 2 follows a perpendicular direction, but the present invention is not limited thereto.

In order to convey the substrate 2, the manufacturing device 1 is provided with an unwinding chamber 3 for unwinding the substrate 2 and a winding chamber 4 for winding the substrate 2. Six film-forming chambers 5a to 5f, for example, are provided between the unwinding chamber 3 and the winding chamber 4. Furthermore, the substrate 2 can be conveyed in a forward feed direction from the unwinding chamber 3 to the winding chamber 4 (shown by an arrow A in the diagram), and a backward feed direction from the winding chamber 4 to the unwinding chamber 3 (shown by an arrow B in the diagram). Moreover, a conveying section between the unwinding chamber 3 and the film-forming chamber 5a, conveying sections between the five adjacent film-forming chambers, and a conveying section between the winding chamber 4 and the film-forming chamber 5f, are each provided with, for example, a pair of first grip rollers 6.

[0018] An unwinding core 3a capable of unwinding the

wound substrate 2 is provided on the inside of the unwinding chamber 3, in a manner as to be able to be able to rotate around its own rotation axis that is along the width direction of the substrate 2. Five rollers 3b to 3f, for example, driven to convey the substrate 2 and controlling the tension thereof are provided on the inside of the unwinding chamber 3 and on a forward feed direction downstream side from the unwinding core 3a, in a manner as to be able to rotate around their own rotation axes that are along the width direction of the substrate 2. The unwinding core 3a and the rollers 3b to 3f are configured to rotate in a manner as to be able to convey the substrate 2 in the forward feed direction and the backward feed direction. Note that the number of rollers provided to be driven for conveying the substrate 2 and controlling the tension thereof as shown in Fig. 1 is merely an example and may not only be the number described above, but also any number that can be changed in accordance with specifications of the manufacturing device 1. It is not necessary to provide the rollers driven to convey the substrate 2 and controlling the tension thereof.

[0019] A winding core 4a capable of winding the substrate 2 is provided on the inside of the winding chamber 4, in a manner as to be able to rotate around its own rotation axis that is along the width direction of the substrate 2. Seven rollers 4b to 4h for conveying the substrate 2 and controlling the tension thereof are provided, as an example, on the inside of the winding chamber 4 and on a forward feed direction upstream side from the winding core 4a, in a manner as to be able to rotate around their own rotation axes that are along the width direction of the substrate 2. The winding core 4a and the rollers 4b to 4h are configured to rotate in a manner as to be able to convey the substrate 2 in the forward feed direction and the backward feed direction. Note that the number of rollers provided for conveying the substrate 2 and controlling the tension thereof as shown in Fig. 1 is merely an example and may not only be the number described above, but also any number that can be changed in accordance with the specifications of the manufacturing device 1. It is not necessary to provide the rollers for conveying the substrate 2 and controlling the tension thereof.

[0020] A structure of each of the film-forming chambers 5a to 5f is described with reference to Figs. 2(a) and 2(b). As shown in Figs. 2(a) and 2(b), the substrate 2 is fed in the forward feed direction (the arrow A), and the first grip rollers 6 are accommodated to the substrate 2 fed in the forward feed direction. High-voltage electrodes 7a to 7f and ground electrodes 8a to 8f are placed, face-to-face, in the film-forming chambers 5a to 5f, respectively. The substrate 2 passes through between each of the high-voltage electrodes 7a to 7f and each of the ground electrodes 8a to 8f. The high-voltage electrodes 7a to 7f and the ground electrodes 8a to 8f are shorter, in the width direction of the substrate 2, than the width of the substrate 2. The thin-film laminated body is not formed neither an upper end part nor a lower end part of

the substrate 2 in the width direction. Film formation gas is supplied into the film-forming chambers 5a to 5f. The film-forming chambers 5a to 5f can be kept hermetic. In these film-forming chambers 5a to 5f, the thin film is formed on the substrate 2 when the substrate 2 is positioned between each of the high-voltage electrodes 7a to 7f and each of the ground electrodes 8a to 8f. Examples of a method for forming a film on the surface of the substrate 2 include CVD (Chemical Vapor Deposition), PVD (Physical Vapor Deposition) and the like. The number of film-forming chambers shown in Fig. 1 is used as an example, and is not limited to the one described above and can be changed in accordance with the specifications of the manufacturing device 1. In addition to the film-forming chambers, a heat chamber for heating the substrate 2 may be provided.

[0021] The manufacturing device 1 is further provided with detection means 9 for detecting the position of the substrate 2 in the width direction. The detection means 9 may be configured to be able to detect, for example, the position of an edge part of the substrate 2 in the width direction. In addition, it is particularly preferred that the detection means 9 be a noncontact sensor or, for example, a transmission-type laser sensor or a reflective photosensor. The detection means 9 is connected to control means 10.

[0022] Each pair of first grip rollers 6 is configured to be able to rotate around rotation axes 6a thereof, and is placed between the adjacent film-forming chambers, in a manner as to sandwich the upper end part of the substrate 2 therebetween. In other words, the pair of first grip rollers 6 sandwiches a section of the substrate 2 that does not have the thin-film laminated body formed thereon. An outer circumferential surface 6b of each of the first grip rollers 6 may be formed of an elastic body. Examples of the elastic body include silicon rubber, fluorine rubber, and other heat-resistant rubbers. In another instance, the outer circumferential surface 6b of each of the first grip rollers 6 may be formed of a synthetic resin such as PTFE and polyimide or may be formed of a material applied with stainless steel, iron, or chrome. Moreover, the outer circumferential surface 6b of each of the first grip rollers 6 may be formed of any materials as long as predetermined performances such as a force for protecting and gripping the substrate 2 can be obtained.

[0023] The first grip rollers 6 are configured to be able to adjust the inclination thereof. A first angle adjusting mechanism 11 for adjusting the inclination of the first grip rollers 6 is described with reference to Figs. 3(a) to 3(c). As shown in Figs. 3(a) to 3(c), by means of the first angle adjusting mechanism 11, the rotation axis 6a of each of the first grip rollers 6 is adjusted to be placed neutrally along the width direction of the substrate 2. A roller shaft 6c is disposed in the first grip roller 6, in a manner as to extend upward from an upper end of the first grip roller 6 along the width direction of the substrate 2. An upper end of the roller shaft 6c is attached rotatably to a roller attachment part 12. A link 13 is also disposed in a manner

as to extend upward from the roller attachment part 12 along the width direction of the substrate 2. An upper part of the link 13 is provided with an engaging roller 14. In the link 13, a link attachment part 13a is provided in the middle of the width direction of the substrate 2, which is located between the roller attachment part 12 and the engaging roller 14. This link attachment part 13a is configured to be able to rotate the link 13 around a link rotation axis 13b that extends in the width direction with respect to the surface of the substrate 2, and is attached to a supporting part 15. Therefore, the link 13 can rotate with respect to the supporting part 15. Moreover, biasing means 16 is disposed between the link 13 and the supporting part 15 and along a conveying direction of the substrate 2. This biasing means 16 may be configured to be able to return the link 13 to a neutral position thereof, by using a coil spring, a plate spring, a torsion spring, a rubber member or the like.

[0024] An actuator 17 is disposed above the link 13. The actuator 17 has an arm 18 that is placed along the width direction with respect to the surface of the substrate 2. A tip end part 18a of the arm 18 is engaged with the engaging roller 14 attached to the link 13. On the other hand, a rotating shaft 19 extending along the width direction of the substrate 2 is attached to a base end part 18b of the arm 18. A lower end of the rotating shaft 19 is attached to the base end part 18b of the arm 18, and an upper end of the rotating shaft 19 is attached to a drive source 20. Therefore, the arm 18 can be rotated by the rotary drive of the drive source 20. Note that this drive source 20 is supported by the supporting part 15, and the drive source 20 of the actuator 17 is connected to the control means 10.

[0025] Operations of the manufacturing device 1 according to the first embodiment of the present invention are now described.

Conveying the substrate 2 and performing film formation on the substrate 2 in the manufacturing device 1 is described with reference to Fig. 1 again. In the unwinding chamber 3, the substrate 2 wound by the unwinding core 3a is unwound while being driven and guided by the rollers 3b to 3f. This substrate 2 leaves the unwinding chamber 3, and is then conveyed sequentially through the film-forming chambers 5a to 5f along the forward feed direction. Subsequently, various thin films are formed on the surface of the substrate 2 in the film-forming chambers 5a to 5f. The substrate 2 obtained after the film formation is conveyed into the winding chamber 4 and wound by the winding core 4a while being driven and guided by the rollers 4b to 4h. The substrate 2 is conveyed along the backward feed direction, if needed.

[0026] Adjusting the position of the substrate 2 conveyed in the forward feed direction is described with reference to Figs. 4(a), 4(b) and 5. When the detection means 9 (see Fig. 2(b)) detects a downward displacement of the substrate 2 conveyed in the forward feed direction, the detection means 9 sends a signal to the control means 10 (see Fig. 2(b)). Next, the control means

10 sends the signal to the drive source 20 of the actuator 17, and the drive source 20 is subjected to rotation control such that the tip end part 18a of the arm 18 is moved in toward the backward feed direction. At this moment, the engaging roller 14 that is engaged with the tip end part 18a of the arm 18 also moves toward the backward feed direction, and the link 13 rotates around the link rotation axis 13b. As a result, the first grip rollers 6 are inclined by an inclination angle θ_1 with respect to the width direction of the substrate 2 such that the lower sides of the first grip rollers 6 are directed toward the forward feed direction along the surface of the substrate 2. In other words, the first grip rollers 6 are inclined upward with respect to the forward feed direction of the substrate 2. Note that in the state in which the first grip rollers 6 are inclined by the inclination angle θ_1 , the link 13 is biased by the biasing means 16 such that the first grip rollers 6 are returned to a neutral position thereof.

[0027] Adjusting the position of the substrate 2 conveyed in the backward feed direction is described with reference to Figs. 6(a), 6(b) and 7. When the detection means 9 (see Fig. 2(b)) detects a downward displacement of the substrate 2 conveyed in the backward feed direction, the detection means 9 sends a signal to the control means 10 (see Fig. 2(b)). Next, the control means 10 sends the signal to the drive source 20 of the actuator 17, and the drive source 20 is subjected to rotation control such that the tip end part 18a of the arm 18 is moved in toward the forward feed direction. At this moment, the engaging roller 14 that is engaged with the tip end part 18a of the arm 18 also moves toward the forward feed direction, and the link 13 rotates around the link rotation axis 13b. As a result, the first grip rollers 6 are inclined by an inclination angle θ_2 with respect to the width direction of the substrate 2 such that the lower sides of the first grip rollers 6 are directed toward the backward feed direction along the surface of the substrate 2. In other words, the first grip rollers 6 are inclined upward with respect to the backward feed direction of the substrate 2. Note that in the state in which the first grip rollers 6 are inclined by the inclination angle θ_2 , the link 13 is biased by the biasing means 16 such that the first grip rollers 6 are returned to the neutral position thereof.

[0028] Here, when the detection means 9 detects that adequate lifting force cannot be obtained due to a lowered gripping force of the first grip rollers 6 and that the substrate 2 remains displaced downward even after position correction is performed thereon, the control means 10 controls the drive source 20 of the actuator 17, in a manner as to increase the inclination angle θ_1 or θ_2 of the first grip rollers 6. As a result, the position of the substrate 2 is corrected. However, when the detection means 9 detects that the lifting force is strong due to an excessively increased gripping force of the first grip rollers 6 and that the substrate 2 is displaced upward after the position correction is performed thereon, the control means 10 controls the drive source 20 of the actuator 17, in a manner as to reduce the inclination angle θ_1 or

θ_2 of the first grip rollers 6. As a result, the position of the substrate 2 is corrected.

[Second Embodiment]

[0029] A device for manufacturing a thin-film laminated body according to a second embodiment of the present invention is described hereinafter. The basic configuration of the device for manufacturing a thin-film laminated body according to the second embodiment is the same as that of the device for manufacturing a thin-film laminated body according to the first embodiment. The same reference numerals and names as those of the first embodiment are used to describe the same components of the first embodiment. The configurations that are different than those of the first embodiment are now described.

[0030] As shown in Fig. 8, a pair of second grip rollers 6' is further provided in a manner as to sandwich the lower end part of the substrate 2 therebetween. As with the first grip rollers 6, each of the second grip rollers 6' has a rotation axis 6a' and an outer circumferential surface 6b'. Although not shown, a second angle adjusting mechanism capable of adjusting an inclination direction and an inclination angle of the second grip rollers 6' is provided to incline the second grip rollers 6' downward with respect to the conveying direction and toward both the forward feed direction and the backward feed direction with respect to the conveying direction, with the outer circumferential surfaces 6b positioned along the surface of the substrate 2. This second angle adjusting mechanism corresponds to the second grip rollers 6' and has the basic configuration as the first angle adjusting mechanism 11. Note that Fig. 8 shows a state in which the substrate 2 is fed in the forward feed direction (the arrow A) and upper sides of the second grip rollers 6' are inclined in the forward feed direction so as to correspond to the substrate 2 fed in the forward feed direction.

[0031] According to the first embodiment and the second embodiment of the present invention described above, the inclination direction and the inclination angle of the first and/or second grip rollers 6, 6' are adjusted by the first angle adjusting mechanism 11 and/or the second angle adjusting mechanism, in a manner that the first and/or second grip rollers 6, 6' are inclined toward both the forward feed direction and the backward feed direction in the conveying direction of the substrate 2. In this manner, the position of the substrate 2 conveyed in the forward feed direction and the backward feed direction can be adjusted with a high degree of accuracy.

[0032] According to the first embodiment and the second embodiment of the present invention, for instance, when the gripping force of the first grip rollers 6 weakens due to the wear of the first grip rollers 6, and adequate lifting force for lifting the substrate 2 cannot be obtained, the position of the substrate 2 can be corrected by increasing the inclination of the first grip rollers 6 and the distance in which the substrate 2 moves in the width direction. As a result, imposing an excess load onto the

substrate 2 can be inhibited without increasing the force of the first grip rollers 6 sandwiching the substrate 2. On the other hand, when the gripping force of the first grip rollers 6 fluctuates and therefore becomes so high that the lifting force for lifting up the substrate 2 becomes excessively strong, the position of the substrate 2 can be corrected by reducing the inclination of the first grip rollers 6 and the distance in which the substrate 2 moves in the width direction. As a result, the accuracy of adjusting the position of the substrate 2 can be prevented from dropping.

[0033] The above has described the embodiments of the present invention. However, the present invention is not limited to these above-described embodiments and can be modified and changed in various ways based on the technical idea of the present invention.

[0034] In a first modification of the embodiments of the present invention, the first and/or second grip rollers 6, 6' may be configured such that the force thereof for sandwiching the substrate 2 therebetween (referred to as "substrate sandwiching force" hereinafter) can be adjusted. For example, when the detection means 9 detects that adequate lifting force for lifting up the substrate 2 cannot be obtained due to a lowered gripping force of the first grip rollers 6 and that the substrate 2 remains displaced downward even after position correction is performed thereon, the control means 10 may control the pair of first grip rollers 6 to correct the position of the substrate 2, in a manner as to increase the substrate sandwiching force of the pair of first grip rollers 6. However, when the detection means 9 detects that the lifting force for lifting up the substrate 2 is strong due to an excessively increased gripping force of the first grip rollers 6 and that the substrate 2 is displaced upward after the position correction is performed thereon, the control means 10 may control the pair of first grip rollers 6 to correct the position of the substrate 2, in a manner as to reduce the substrate sandwiching force of the pair of first grip rollers 6. In this manner, the same effects as those of the present invention can be obtained.

[0035] In a second modification of the embodiments of the present invention, the first and/or second grip rollers 6, 6' may be provided in at least one conveying section out of the conveying section between the unwinding chamber 3 and the film-forming chamber 5a, the conveying sections between the five adjacent film-forming chambers, and the conveying section between the winding chamber 4 and the film-forming chamber 5f. The number of conveying sections provided with the first and/or second grip rollers 6, 6' can be changed such that the position of the substrate 2 can be adjusted appropriately. In addition, the number of the first and/or second grip rollers 6, 6' provided in each conveying section may be two or more. In this manner, the same effects as those of the present invention can be obtained.

[0036] In a third modification of the embodiments of the present invention, in place of the roller attachment part 12, a drive source for rotating the first and/or second

grip rollers 6, 6' may be provided so that the first and/or second grip rollers 6, 6' can be rotated by this drive source. This drive source may be connected to the control means 10 to rotate the first and/or second grip rollers 6, 6'. In this manner, the same effects as those of the present invention can be obtained.

[Example]

[0037] An example using the manufacturing device 1 of the first embodiment of the present invention is now described. In the example according to the present invention, the substrate sandwiching force of a pair of the first grip rollers 6 was set at 4.4 N, 8.9 N or 16.3 N, and changes in a lifting force F of the pair of first grip rollers 6 (referred to as "lifting force" hereinafter) for lifting up the substrate 2 were measured when the inclination angle θ_1 or θ_2 of the first grip rollers 6 was changed between 0° to 8°.

[0038] Fig. 9 shows a relationship between the inclination angle θ_1 or θ_2 of the first grip rollers 6 and the lifting force F of the first grip roller 6 for lifting up the substrate 2, wherein a solid line P shows that the substrate sandwiching force is 4.4 N, a dashed line Q shows that the substrate sandwiching force is 8.9 N, and a chain line R shows that the substrate sandwiching force is 16.3 N.

[0039] As shown in Fig. 9, it is clear that the lifting force F increases in proportion to the inclination angle θ_1 or θ_2 . For example, in order to obtain approximately 2 N for the lifting force F for lifting the substrate 2, and when the substrate sandwiching force is 4.4 N, the inclination angle θ_1 or θ_2 may be approximately 3.5°. When the substrate sandwiching force is 8.9 N, the inclination angle θ_1 or θ_2 may be approximately 2°. When the substrate sandwiching force is 16.3 N, the inclination angle θ_1 or θ_2 may be approximately 1°. According to the example of the present invention illustrated above, it was confirmed that, instead of increasing the substrate sandwiching force of the pair of first grip rollers 6, the lifting force F can be increased by increasing the inclination angle θ_1 or θ_2 of the first grip rollers 6.

EXPLANATION OF REFERENCE NUMERALS

[0040]

- 1 Device for manufacturing thin-film laminated body (manufacturing device)
- 2 Film substrate (substrate)
- 6 First grip roller
- 6' second grip roller
- 6a, 6a' Rotation axis
- 6b, 6b' Outer circumferential surface
- 9 Detection means
- 11 Angle adjusting mechanism
- A, B, C, D, D', D" Arrow
- F Lifting force

θ_1, θ_2 Inclination angle

P Solid line

Q Dashed line

R Chain line

the substrate.

5

Claims

1. A film substrate conveying device for conveying a belt-like film substrate while placing the film substrate upright, with one end part thereof being on an upper side in a width direction thereof, the film substrate conveying device comprising:
 - at least a pair of first grip rollers that is disposed so as to sandwich an upper end part of the film substrate therebetween; and
 - a first angle adjusting mechanism that is capable of adjusting an inclination direction and an inclination angle of the first grip rollers so as to be able to incline a rotation axis angle of the first grip rollers such that a rotation direction of the first grip rollers is on an upper side with respect to a conveying direction.
2. The film substrate conveying device according to claim 1, further comprising:
 - at least a pair of second grip rollers that is disposed so as to sandwich a lower end part of the film substrate therebetween; and
 - a second angle adjusting mechanism that is capable of adjusting an inclination direction and an inclination angle of the second grip rollers so as to be able to incline a rotation axis angle of the second grip rollers such that a rotation direction of the second grip rollers is on a lower side with respect to the conveying direction.
3. The film substrate conveying device according to claim 1 or 2, further comprising:
 - detection means for detecting a level of a width direction end part of the film substrate, wherein when the detection means detects a displacement of the film substrate, the first angle adjusting mechanism and/or the second angle adjusting mechanism performs control to incline the first grip rollers and/or the second grip rollers in an inclination direction corresponding to the conveying direction of the film substrate.
4. The film substrate conveying device according to any one of claims 1 to 3, wherein the first angle adjusting mechanism and/or the second angle adjusting mechanism performs control to change the inclination angle of the first grip rollers and/or the second grip rollers in order to correct the displacement of

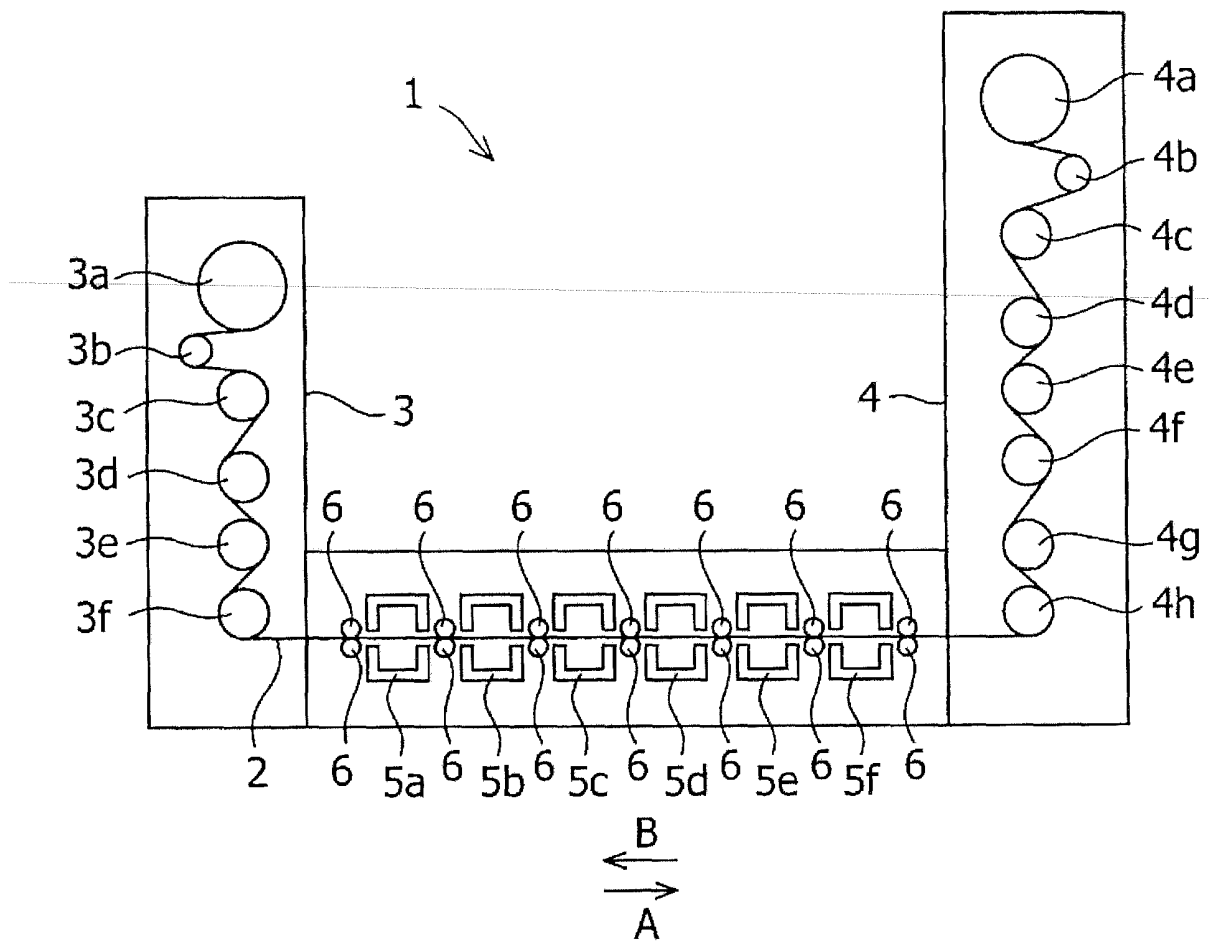


Fig. 1

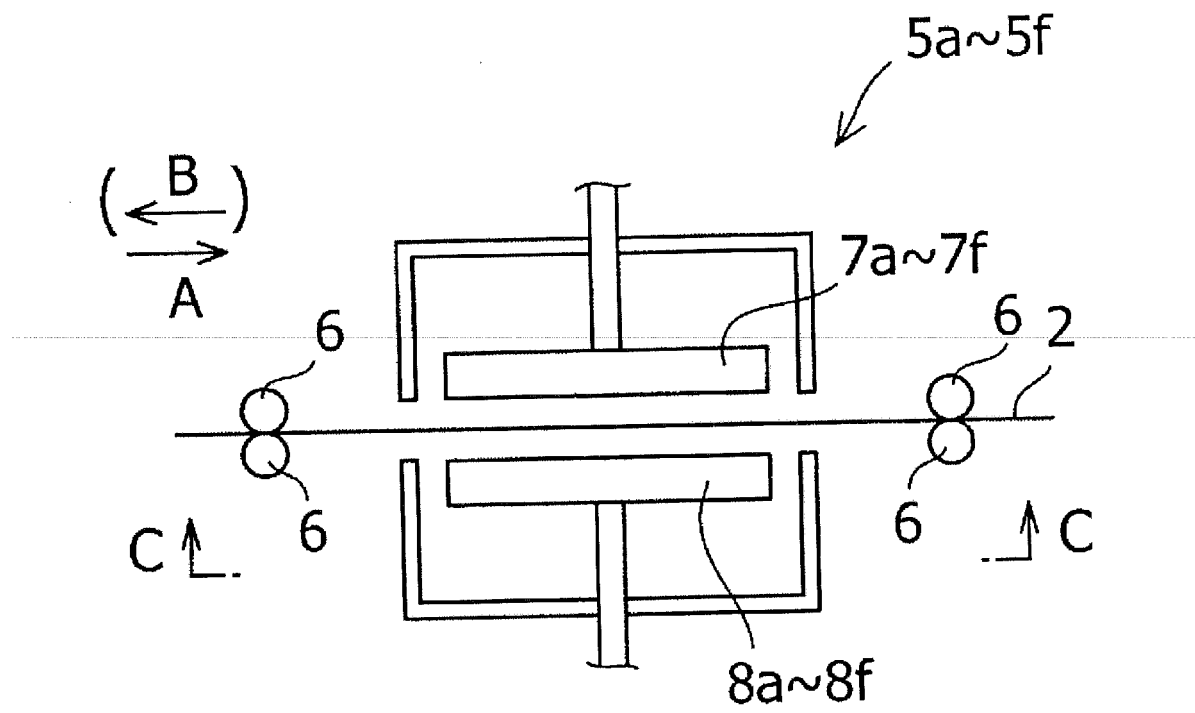


Fig. 2a

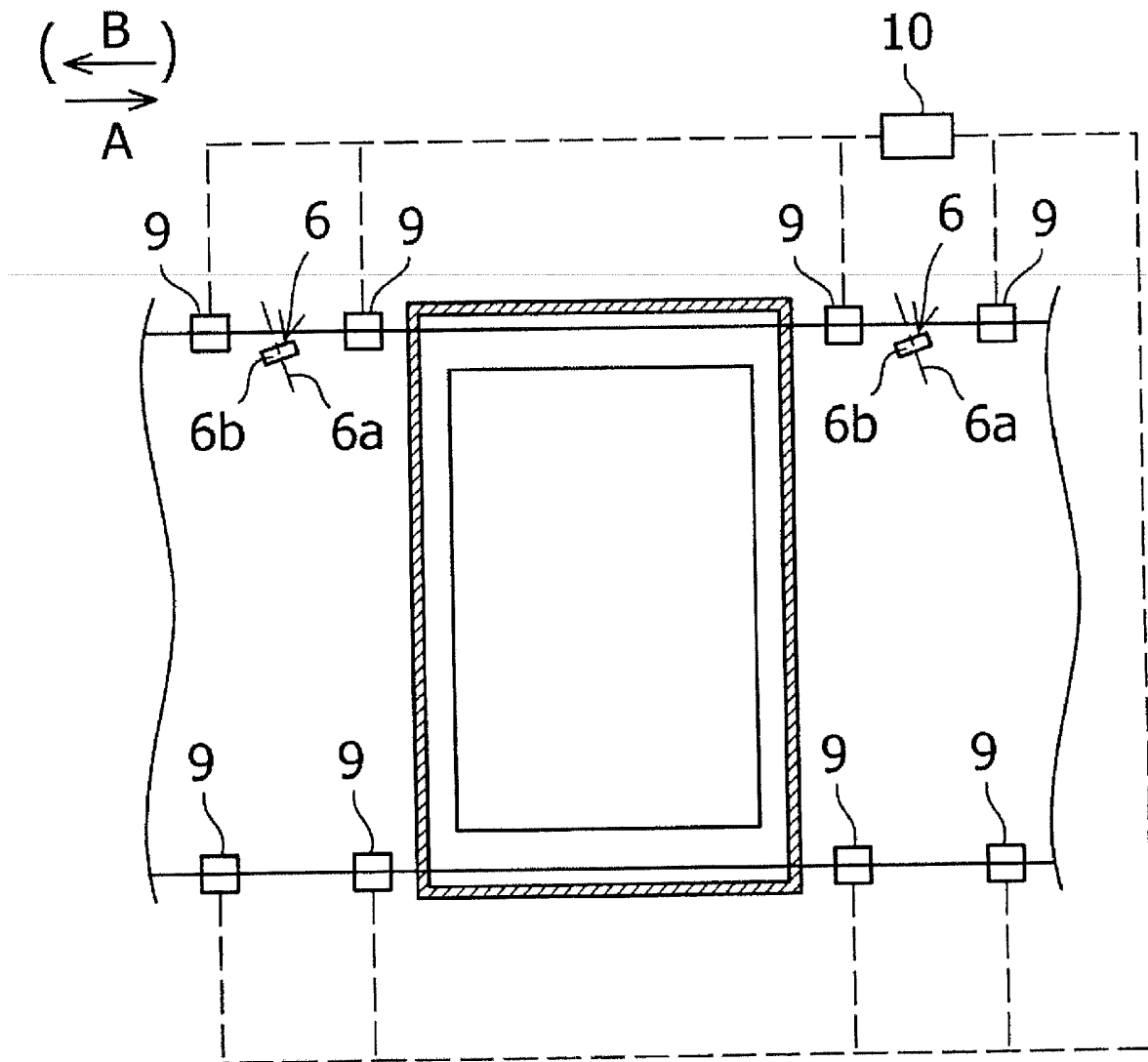
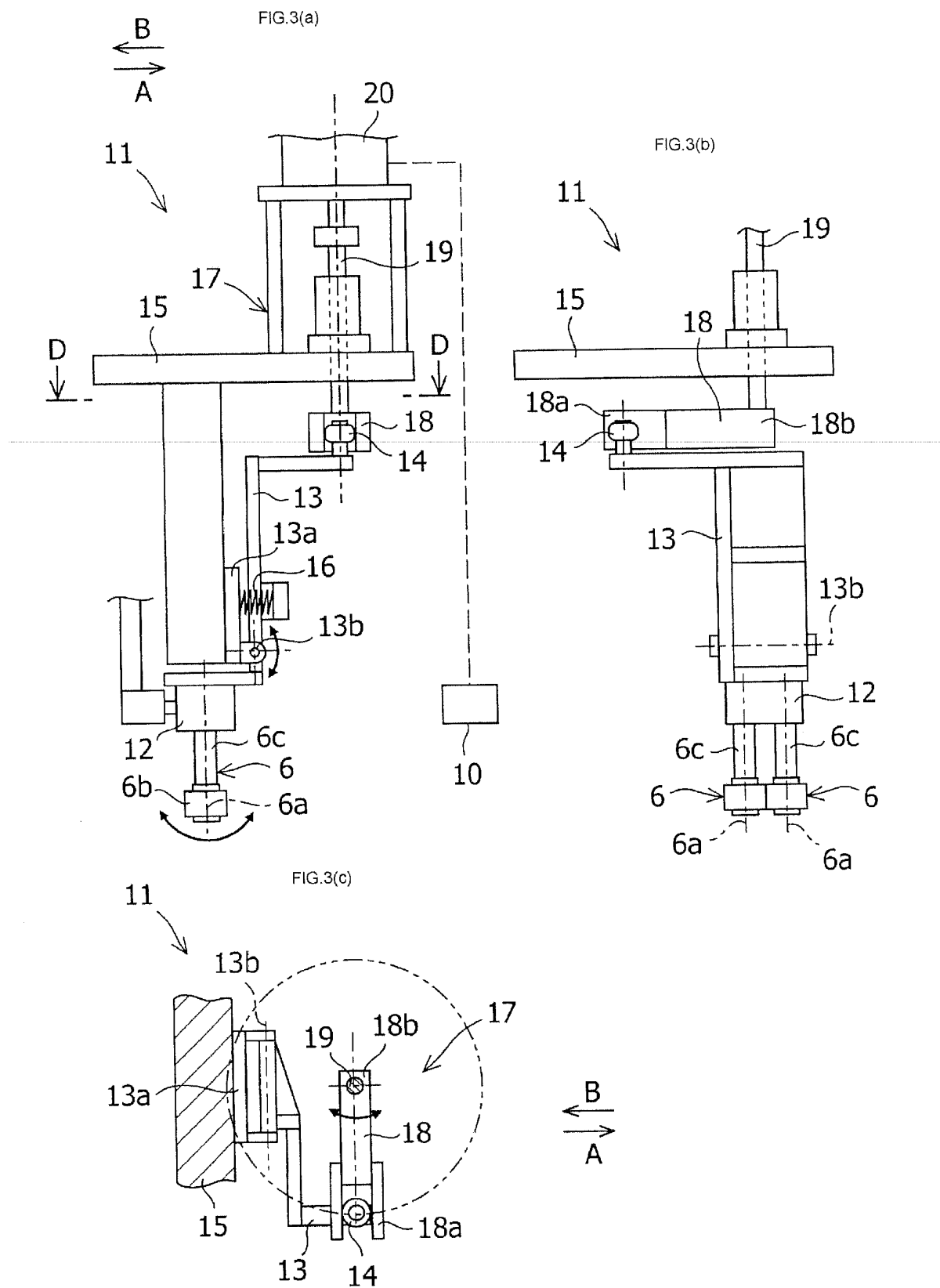


Fig. 2b



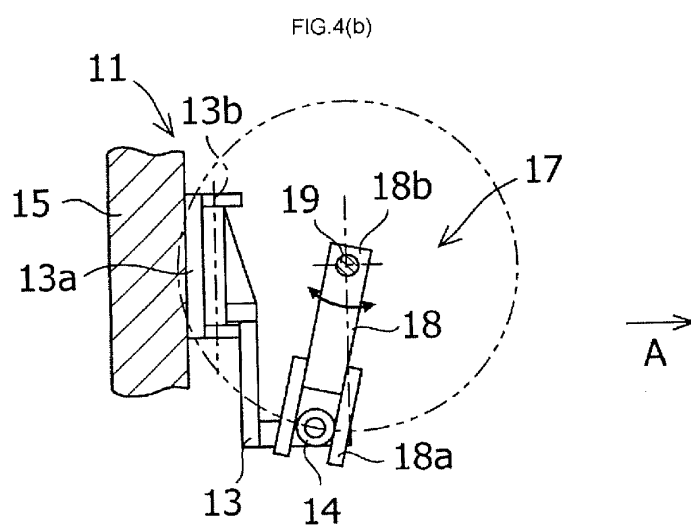
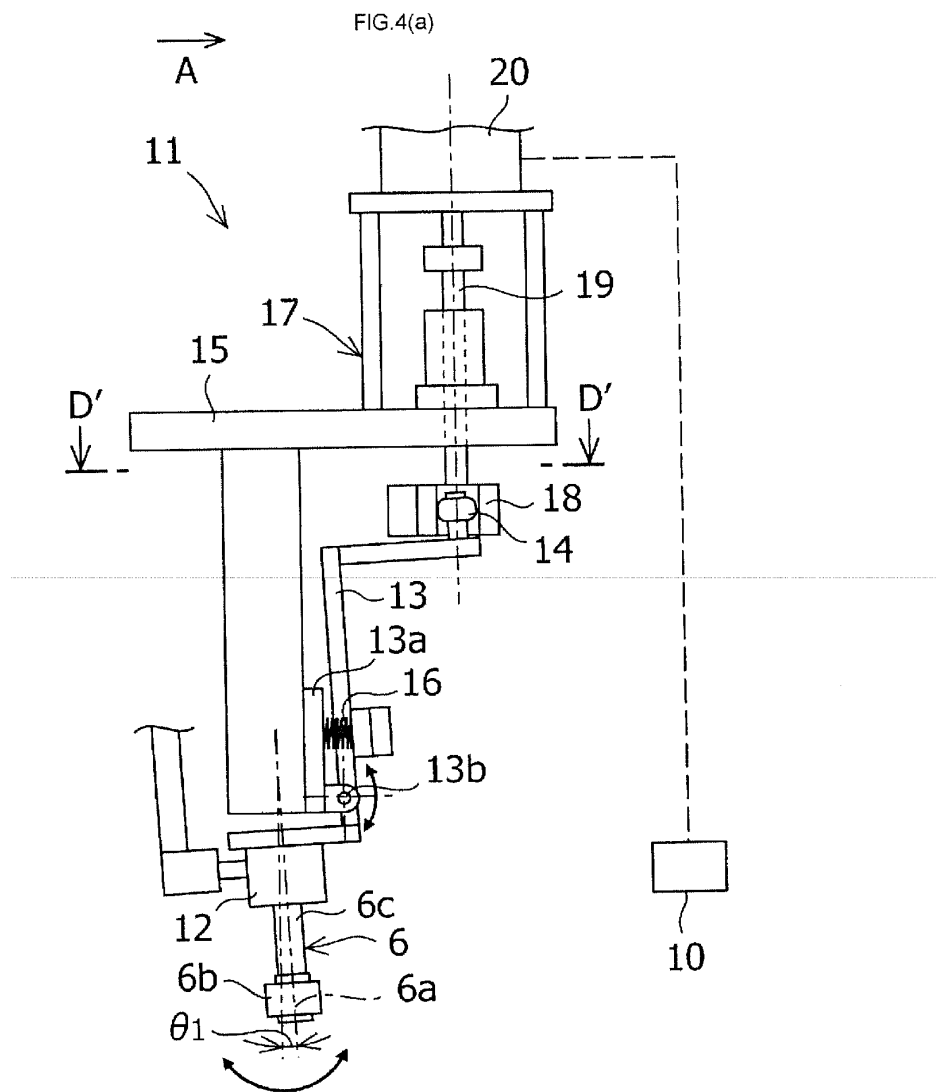


Fig. 4

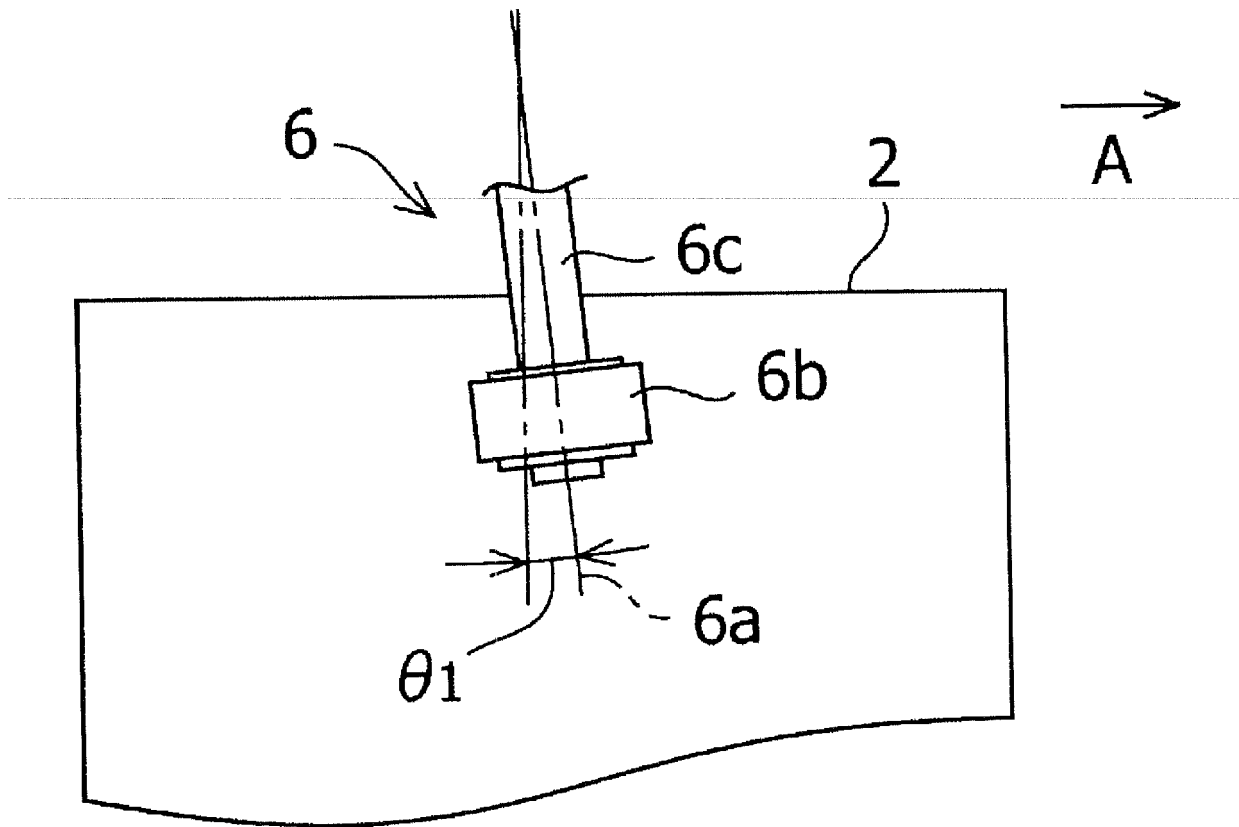


Fig. 5

FIG.6(a)

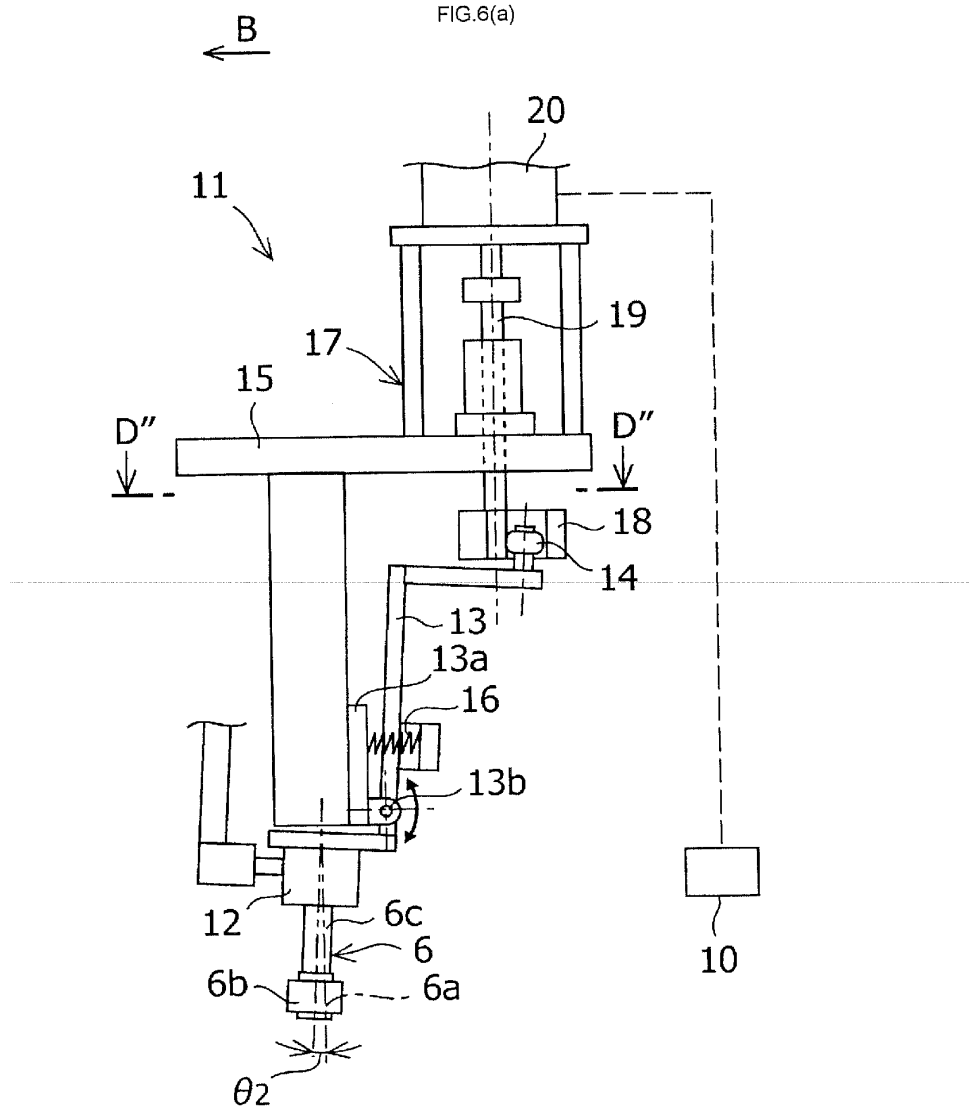


FIG.6(b)

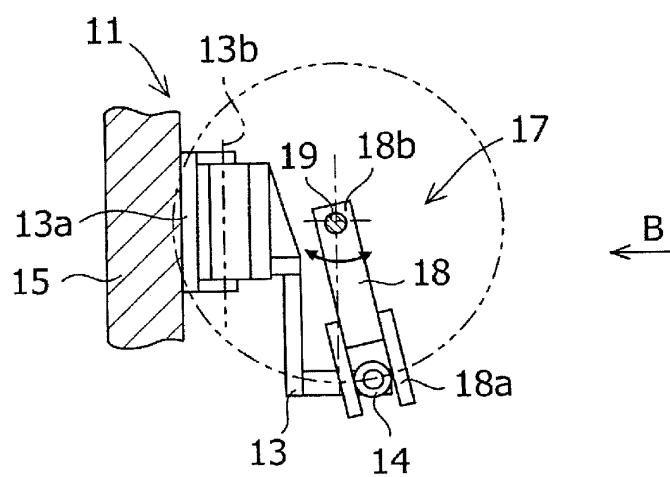


Fig. 6

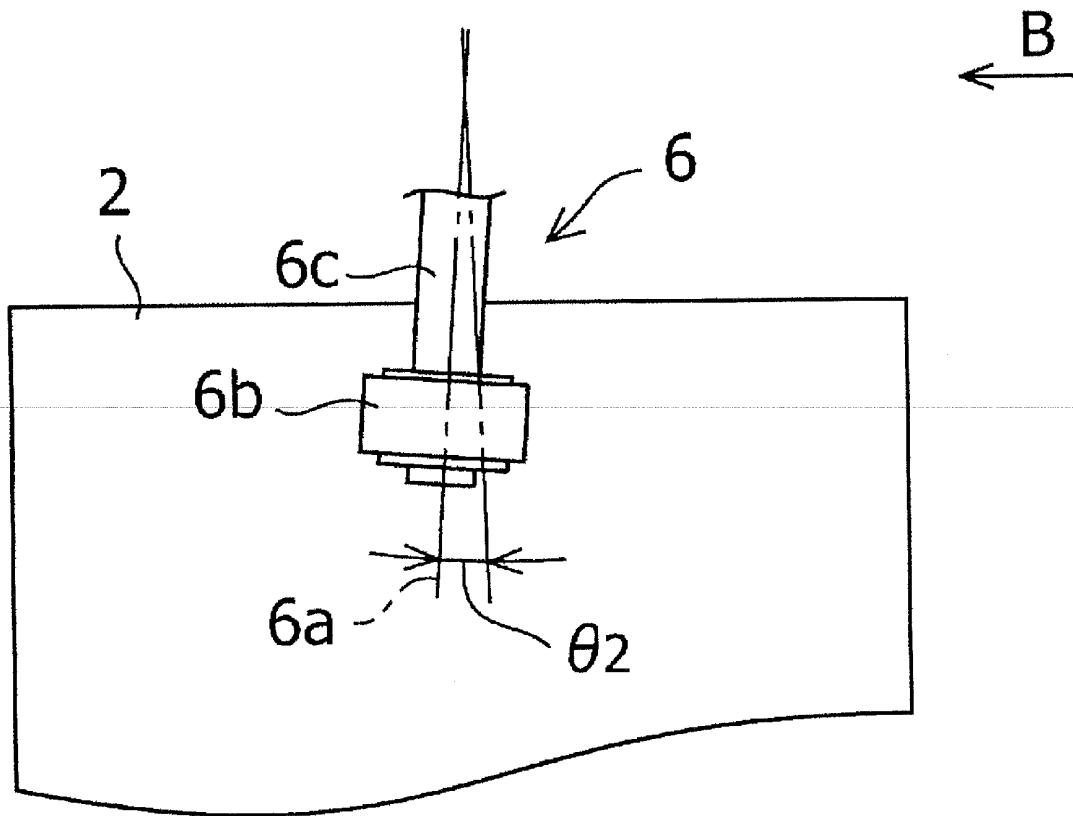


Fig. 7

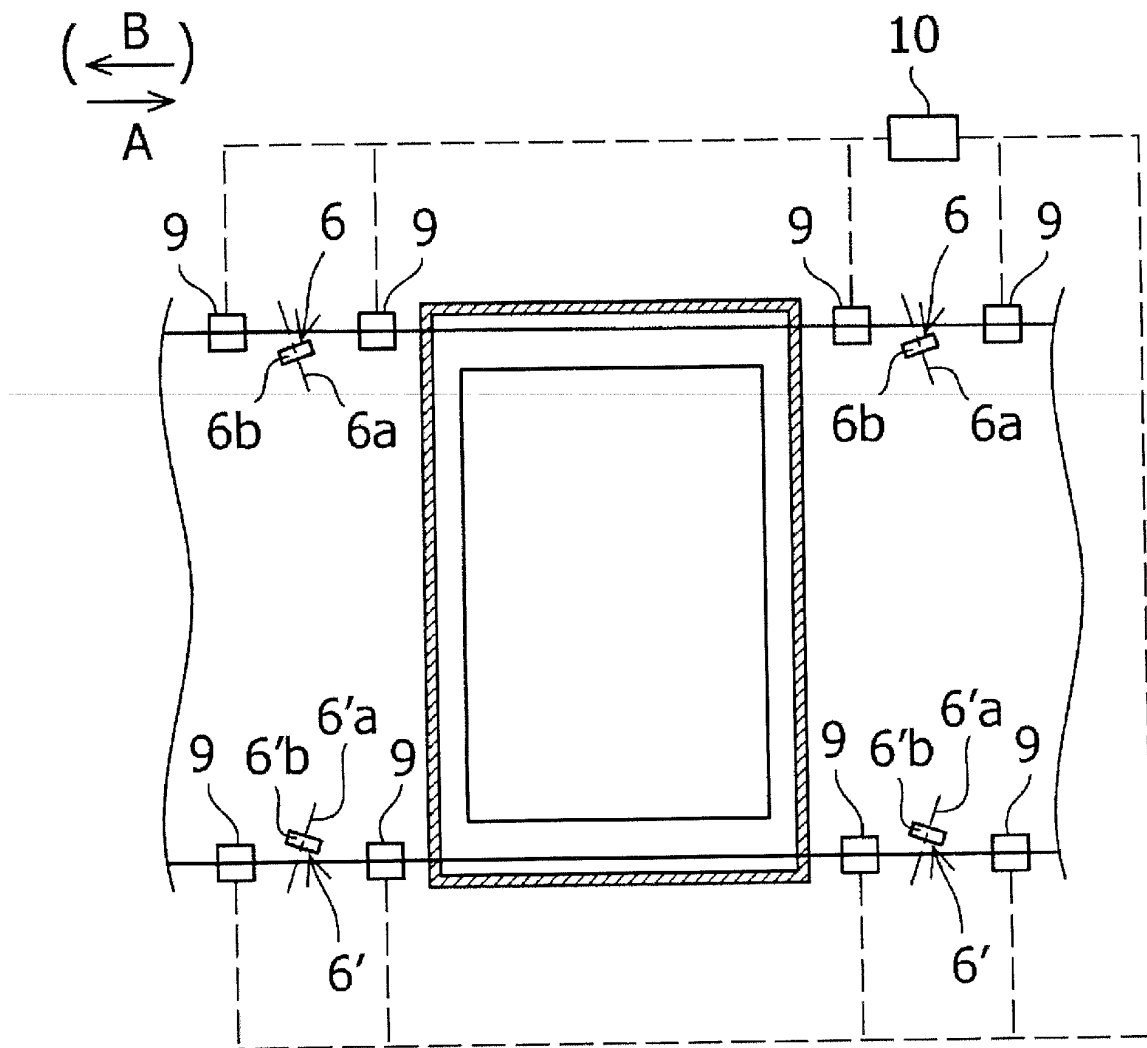


Fig. 8

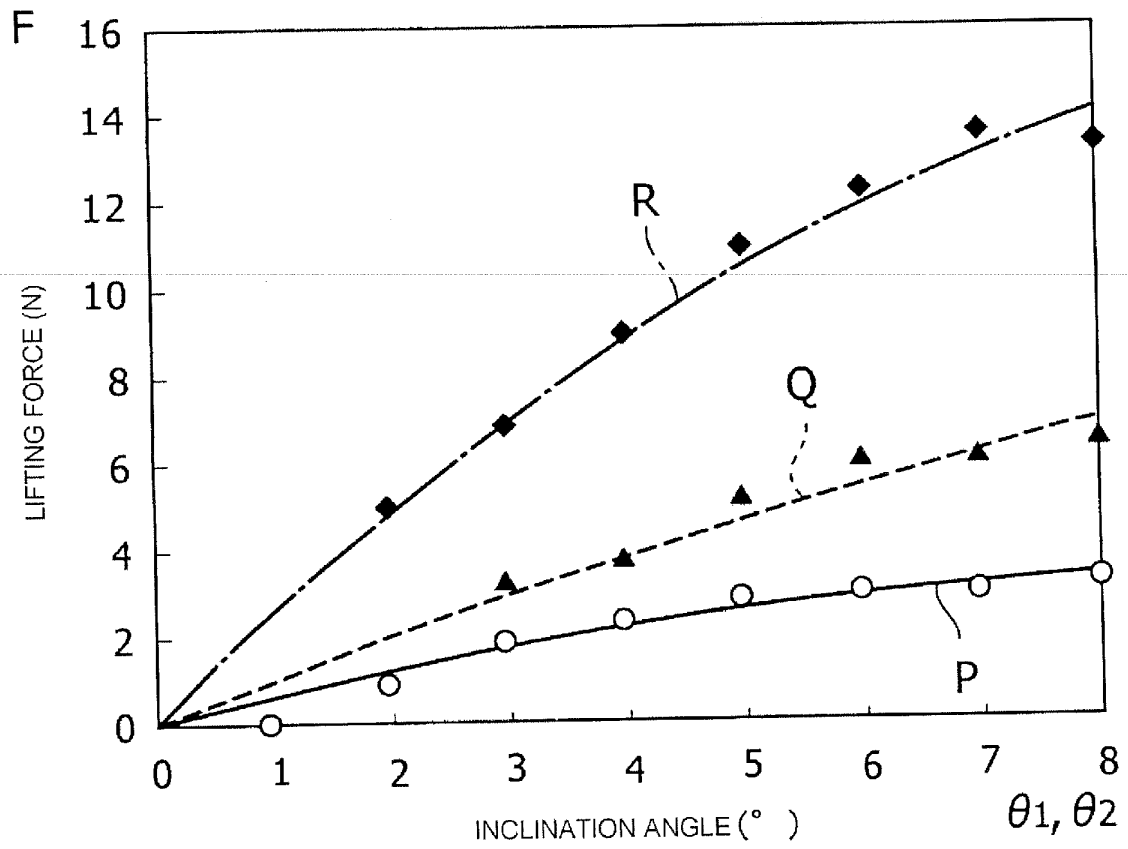


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/070787

A. CLASSIFICATION OF SUBJECT MATTER

C23C14/56(2006.01)i, B65H9/16(2006.01)i, B65H23/025(2006.01)i, B65H23/038(2006.01)i, C23C16/44(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C23C14/00-14/58, B65H9/16, B65H23/025, B65H23/038, C23C16/00-16/56

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2009-057632 A (Fuji Electric Holdings Co., Ltd.), 19 March 2009 (19.03.2009), claims; paragraphs [0018], [0031]; examples & US 2009/0047114 A1 & EP 2020392 A2	1-4
A	JP 2004-269113 A (TDK Corp.), 30 September 2004 (30.09.2004), entire text & US 2004/0175508 A1	1-4
A	JP 2005-508816 A (Gebr. Schmid GmbH & Co.), 07 April 2005 (07.04.2005), entire text & US 2005/0073084 A1 & EP 1442646 A & WO 2003/041475 A1	1-4

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
24 December, 2010 (24.12.10)Date of mailing of the international search report
11 January, 2011 (11.01.11)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/070787

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 9-130023 A (Fujitsu Ltd.), 16 May 1997 (16.05.1997), entire text (Family: none)	1-4
A	JP 9-127706 A (E.I. Du Pont De Nemours & Co.), 16 May 1997 (16.05.1997), entire text & US 5653929 A & EP 762213 A3 & EP 762213 A2	1-4

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2009038276 A [0006]