



(11)

EP 2 873 798 A1

(12)

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

(43) Date of publication:
20.05.2015 Bulletin 2015/21

(51) Int Cl.:
E06B 9/322 ^(2006.01) **E06B 9/02** ^(2006.01)
E06B 9/302 ^(2006.01)

(21) Application number: **13808686.3**

(86) International application number:
PCT/JP2013/000768

(22) Date of filing: **13.02.2013**

(87) International publication number:
WO 2014/002326 (03.01.2014 Gazette 2014/01)

(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**
Designated Extension States:
BA ME

(72) Inventor: **OHISHI, Mamoru**
Omiachiman-shi
Shiga 523-0034 (JP)

(30) Priority: **28.06.2012 JP 2012146155**

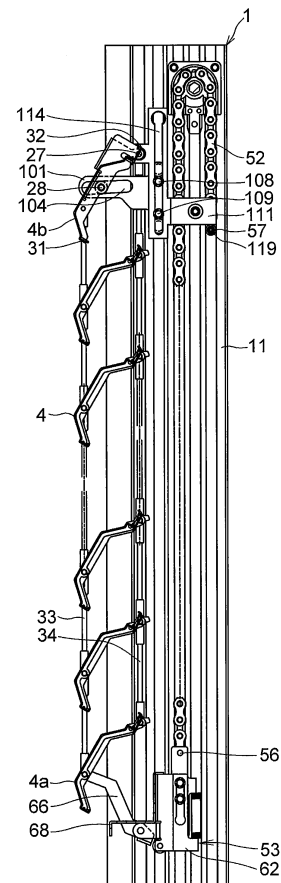
(74) Representative: **Jackson, Martin Peter**
J A Kemp
14 South Square
Gray's Inn
London WC1R 5JJ (GB)

(71) Applicant: **Oiles Eco Corporation**
Tokyo 141-0031 (JP)

(54) **BLIND APPARATUS**

(57) A window blind apparatus 1 includes a frame 3 defining an opening 2; a plurality of slats 4 juxtaposed to each other in the opening 2 in a direction Z; a pair of link mechanisms 5 for linking the plurality of slats 4 to each other; a raising and lowering mechanism 6 for raising and lowering the plurality of slats 4, starting with a lowermost slat 4a; and a tilting means 7 which is disposed on a rear side of the slat 4 and tilts the plurality of slats 4 on the basis of the raising and lowering of the slat 4a by the raising and lowering mechanism 6.

FIG. 5



EP 2 873 798 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a window blind apparatus which is disposed in a window of a building to hinder sight and shut out light for the interior of a room.

BACKGROUND ART

[0002] Window blind apparatuses are known in which a plurality of slats are arranged vertically in a window of a building to hinder sight and shut out natural light or artificial light for the interior of a room by the raising/lowering and tilting of the slats. For example, in Patent Document 1, a window blind device is proposed which is provided with a raising and lowering device for raising and lowering the slats and a tilting means (a tilting mechanism) for tilting the slats. In a window blind apparatus which is installed on the interior side or the exterior side, in a case where the window is fully opened, the plurality of slats superposed on each other and bundled are generally disposed on the ceiling side. Incidentally, with the window blind apparatus, the plurality of slats, which, in the full opening of the window, are superposed on each other and bundled so as not to obstruct the field of view through the window and, where necessary, to allow sufficient daylight to be obtained, are preferably disposed on the ceiling side without greatly covering an upper portion of the window. However, there is a possibility that, owing to the occupying space of a slats raising-and-lowering device and a slats tilting mechanism, the upper portion of the window is greatly covered by these bundled slats unless the ceiling is made high. In addition, in the window blind apparatus, since the tilting of the plurality of slats by the tilting means is effected with a fixed rotating shaft as a center in the front-back direction of the slats, front edge portions of the slats jut out forward, with the result that it is difficult to render the window blind apparatus itself and an installation area thereof compact.

[0003] To overcome the above-described problems, in Patent Document 2, for example, a window blind apparatus is proposed which comprises: a plurality of slats juxtaposed to each other in a vertical direction; a link mechanism for linking the plurality of slats to each other; a raising and lowering mechanism for raising and lowering the plurality of slats in the vertical direction, starting with a lowermost slat among the plurality of slats; and tilting means disposed on a rear side of the slat and adapted to tilt the plurality of slats on the basis of the raising and lowering of the slats by the raising and lowering mechanism, wherein the tilting means includes a slat supporting mechanism for supporting an uppermost slat among the plurality of slats rotatably and movably in a front-back direction and a moving mechanism which is rotatably connected to the uppermost slat at a rear edge portion thereof located rearwardly of a portion thereof supported by the slat supporting mechanism, the moving

mechanism being adapted to move the rear edge portion of the uppermost slat in the vertical direction on the basis of the raising and lowering of the slats by the raising and lowering mechanism, so as to tilt the slats by a relative displacement of the rear edge portion of the uppermost slat in the vertical direction with respect to the portion of the uppermost slat supported by the slat supporting mechanism. The slat supporting mechanism includes a slat supporting member for supporting the uppermost slat rotatably and movably in the front-back direction, and the moving mechanism includes a linearly movable member which is linearly movable in the vertical direction and is rotatably connected to the rear edge portion of the uppermost slat, the rear edge portion being located rearwardly of a portion of the uppermost slat which is supported by the slat supporting member, and a transmitting mechanism for releasably transmitting the operation of the raising and lowering mechanism to the linearly movable member so as to linearly move the linearly movable member in the vertical direction. The raising and lowering mechanism has a rotating shaft which rotates so as to raise and lower the plurality of slats, and the transmitting mechanism includes a rack and pinion mechanism for imparting a linearly moving force in the vertical direction to the linearly movable member on the basis of the rotation of the rotating shaft, a sliding mechanism which transmits the rotation of the rotating shaft to the rack and pinion mechanism while undergoing sliding with respect to the rotating shaft to release the transmission of that rotation when a rotational load of a predetermined level or higher has occurred, and a linear-movement inhibiting mechanism for releasably inhibiting the linear movement of the linearly movable member directed upward from a predetermined position.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0004]

Patent Document 1: JP-A-2004-156289

Patent Document 2: JP-A-2007-239309

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] Meanwhile, with such a window blind apparatus, since the linearly movable member is linearly moved in the vertical direction by transmitting the operation of the raising and lowering mechanism to the linearly movable member by using the rack-and-pinion mechanism or the like, there is a possibility that the apparatus is rendered complex. In addition, in the case where the rack-and-pinion mechanism or the like is installed separately from the raising and lowering mechanism, it is difficult to

render the apparatus compact.

[0006] The present invention has been devised in view of the above-described aspects, and its object is to provide a window blind apparatus which makes it possible to transmit the operation of the raising and lowering mechanism with a simple configuration and allow the slats to be tilted and which makes it possible to render the apparatus compact.

MEANS FOR SOLVING THE PROBLEMS

[0007] The window blind apparatus in accordance with the present invention comprises: a frame defining an opening; a plurality of slats juxtaposed to each other in the opening in a vertical direction; a pair of link mechanisms for linking the plurality of slats to each other; a raising and lowering mechanism for raising and lowering the plurality of slats, starting with a lowermost slat; and tilting means which is disposed on a rear side of the slat and tilts the plurality of slats on the basis of the raising and lowering of the slats by the raising and lowering mechanism, wherein the raising and lowering mechanism includes a rotating body rotatably supported by the frame, a flexible elongated member wound around the rotating body so as to travel on one side in the vertical direction and to travel on another side in an opposite direction, and a coupling mechanism for coupling one side of the elongated member to the lowermost slat to allow the traveling of the elongated member on one side to be transmitted to the plurality of slats, and wherein the tilting means includes: a slat supporting mechanism including a slat supporting member for supporting a supported portion of an uppermost slat of the plurality of slats rotatably and movably in a front-back direction and mounting means for mounting the slat supporting member to the frame; and a linearly moving mechanism including a linearly movable member which rotatably supports a rear edge portion of the uppermost slat located rearwardly of the supported portion, is linearly movable in the vertical direction, and in a linear movement thereof in the vertical direction causes the slat to tilt by the relative displacement of the rear edge portion in the vertical direction relative to the supported portion, and transmitting means for transmitting the traveling of the flexible elongated member on the other side to the linearly movable member so as to linearly move the linearly movable member in the vertical direction on the basis of the raising and lowering of the slats by the raising and lowering mechanism, the transmitting means having an abutment member which is mounted on another side of the elongated member and which, in order to transmit the traveling on the other side of the elongated member in the vertical direction to the linearly movable member, abuts against the linearly movable member in that traveling.

[0008] According to the window blind apparatus in accordance with the invention, it is possible to transmit the operation of the raising and lowering mechanism with a simple configuration and allow the slats to be tilted. More-

over, it is possible to eliminate the need to install a rack-and-pinion mechanism or the like separately from the raising and lowering mechanism, so that it is possible to render the apparatus compact.

[0009] In the present invention, the supported portion of the uppermost slat which is supported by the slat supporting member may be located forwardly of a center of gravity of the slat, in which case a rotational force is produced in the slat at the time of opening the opening due to an own weight thereof, with the result that the opening open state can be stably maintained without needing to install a complex mechanism.

[0010] The window blind apparatus in accordance with the invention may further comprise urging means for urging the uppermost slat in a tilting direction when the opening is opened, and the urging means may include a resiliently urging member constituted by a coil spring or the like for urging the linearly movable member in the vertical direction. Such a resiliently urging member may be connected, for example, to the linearly movable member and the frame so as to resiliently urge the linearly movable member in the vertical direction. Additionally, as the urging means, a weight may be provided as a load in the longitudinal direction of a rear side of the slat.

[0011] In the present invention, the slat supporting member may include an elongated hole or a slit which extends in the front-back direction and in which the supported portion of the uppermost slat is disposed movably in the front-back direction. The elongated hole or the slit may be inclined forwardly downwardly.

[0012] In the present invention, the slat supporting member may be mounted on the frame linearly movably in the vertical direction, and the frame may be provided with a stopper for stopping the lowering of the slat supporting member by more than a predetermined amount by abutting against the slat supporting member. In such a case, the plurality of slats which are superposed on each other on the basis of the operation of the raising and lowering mechanism can be accommodated in an upper portion of the frame, which makes it possible to enlarge the opening and make effective use of the upper space of the frame, thereby making it possible to render the apparatus compact.

[0013] In the present invention, the linearly movable member may be connected to the slat supporting member so as to undergo relative displacement by a predetermined amount in the vertical direction relative to the slat supporting member, the linearly movable member may have an elongated hole or a slit extending in the vertical direction, and the slat supporting member may have a shaft which is disposed in the elongated hole or the slit vertically movably. At least two shafts are provided in the slat supporting member as the shaft, and these at least two shafts may be opposed to each other in the vertical direction.

[0014] In the present invention, an end portion on the one side of the elongated member may be connected to the lowermost slat through the coupling mechanism, and

the abutment member may be mounted on the end portion on the other side of the elongated member.

[0015] In the present invention, the end portion on the one side of the elongated member may be located on a forward side in the front-back direction relative to the end portion on the other side of the elongated member.

[0016] In the present invention, the rotating body may be constituted by a sprocket wheel, and the elongated member may be constituted by a chain wound around the sprocket wheel.

[0017] In the present invention, the link mechanism may include a first link member for connecting the plurality of slats to each other and a second link member disposed rearwardly of the first link member and connecting the plurality of slats to each other, at least one of the first and the second link members having one continuous flexible cord-like member which is rotatably connected at an upper end thereof to a longitudinal end portion of the uppermost slat and is rotatably connected at a lower end thereof to a longitudinal end portion of the lowermost slat, and a plurality of rotational connectors which are secured to the cord-like member and are respectively rotatably connected to longitudinal end portions of the slats excluding the uppermost slat and the lowermost slat, an upper end of the rotational connector at the time of opening of the opening being rotatably connected to a lower end of another rotational connector upwardly adjacent to that rotational connector, a lower end of the rotational connector at the time of opening of the opening being rotatably connected to an upper end of another rotational connector downwardly adjacent to that rotational connector. In substitution for the above-described cord-like member and rotational connectors, the link mechanism may include a first link member for connecting the plurality of slats to each other and a second link member disposed rearwardly of the first link member and connecting the plurality of slats to each other, at least one of the first and the second link members having a plurality of rotational connectors which are respectively rotatably connected to longitudinal end portions of the slats excluding the uppermost slat and the lowermost slat, and flexible cord-like members which connect an upper end of the rotational connector to a lower end of another rotational connector upwardly adjacent to that rotational connector at the time of opening of the opening, and connect a lower end of the rotational connector to an upper end of another rotational connector downwardly adjacent to that rotational connector at the time of opening of the opening, wherein the cord-like member, which is secured at an one end thereof to the upper end, at the time of opening of the opening, of the rotational connector connected to the slat adjacent to the uppermost slat in the vertical direction, may be rotatably connected at another end thereof to the uppermost slat, while the cord-like member, which is secured at another end thereof to the lower end, at the time of opening of the opening, of the rotational connector connected to the slat adjacent to the lowermost slat in the vertical direction,

may be rotatably connected at another end thereof to the lowermost slat. According to the above-described window blind apparatus in accordance with the present invention, when the plurality of slats are raised on the basis of the operation of the raising and lowering mechanism, one of the set of the upper ends and the set of the lower ends of the plurality of rotational connectors during the opening of the opening are located on one side in the front-back direction, and the other one of the set of the upper ends and the set of the lower ends are located on the other side in the front-back direction, with the result that the cord-like members can be folded with regularity. Hence, the link member can be configured simply and with light weight, and it is possible to secure stable operation of the apparatus.

[0018] A hole or a recess into which an end portion of the cord-like member is inserted and a retaining pawl for retaining the end portion of the cord-like member to prevent the end portion of the cord-like member inserted in the hole or the recess from coming off may be formed in each of both ends of the plurality of rotational connectors, in which case it is possible to attain improvement of ease in assembling the link members. In addition, an enlarged portion may be formed at each of the end portions of the cord-like member, in which case it is possible to more reliably prevent the coming off of the end portions of the cord-like member retained by the retaining pawl.

[0019] Each of the plurality of rotational connectors may have at an intermediate portion between the upper end and the lower end thereof a connecting portion which is rotatably connected to a corresponding one of the slats, and the connecting portion of each of the plurality of rotational connectors may be detachably connected to the longitudinal end portion of a corresponding one of the slats in a snap-fitting manner.

[0020] The cord-like member may be constituted by a woven fabric of a synthetic resin yarn or a braid of a synthetic resin yarn such as a cord or a rope, or may be a wire rope.

[0021] The plurality of rotational connectors may be respectively arranged at equal intervals therebetween at the time of opening of the opening.

[0022] In the window blind apparatus in accordance with the invention, the frame may have a pair of vertical frames which oppose each other in a lateral direction, at least one of the pair of vertical frames may have an outer frame and an inner frame which is covered by the outer frame and is detachably mounted on the outer frame, and the inner frame may have guide grooves for guiding the elongated member and the mounting means of the slat supporting member in the vertical direction. In such a case, the operation of mounting the plurality of slats and the maintenance and inspection of the link mechanism and the like can be carried out simply and speedily.

[0023] In the window blind apparatus in accordance with the invention, the coupling mechanism may include a coupling main body coupled to the elongated member, a coupling arm which is rotatably coupled at an one end

thereof to the lowermost slat and is rotatably coupled at another end thereof to the coupling main body, and a seat plate which is mounted on the coupling main body in such manner as to extend in the lateral direction and on which the lowermost slat is seated when the opening is opened, wherein the seat plate may have a seat plate portion which extends in the lateral direction and on which the lowermost slat is seated when the opening is opened and a cover plate portion which is connected to a rear edge of the seat plate portion in such a manner as to extend in the vertical direction and covers an underside part underneath the lowermost slat when the opening is closed. According to such a window blind apparatus of the invention, particularly since the seat plate has the seat plate portion which extends in the lateral direction and on which the lowermost slat is seated when the opening is opened and the cover plate portion which is connected to the rear edge of the seat plate portion in such a manner as to extend in the vertical direction and covers the underside part underneath the lowermost slat when the opening is closed, at the time when the opening is opened, the lowermost slat can be seated on the seat plate portion, and the other plurality of slats can be stacked on that lowermost slat, thereby making it possible to accommodate the plurality of slats compactly. Meanwhile, at the time when the opening is closed, the underside part underneath the lowermost slat can be covered by the cover plate portion of the seat plate which has been relatively lowered with respect to the lowermost slat by the operation of the raising and lowering mechanism, thereby making it possible to obtain a preferable opening closed state.

[0024] One end of the coupling arm may be rotatably coupled to the lowermost slat forwardly of a center of gravity of the slat, in which case a rotational force can be produced in the slat at the time of opening the opening due to an own weight thereof, so that it is possible to secure more stable operation of the apparatus.

[0025] The above-described coupling mechanism may further include a hampering piece which is integrally formed with the other end of the coupling arm and is brought into contact with the coupling main body so as to hamper the rotation of the coupling arm by more than a predetermined amount which occurs when the coupling main body is raised with respect to the lowermost slat by the traveling of the elongated member.

[0026] The above-described coupling mechanism may further include a coupling member for coupling the coupling main body to the elongated member and a resilient member interposed between the coupling main body and the coupling member in the vertical direction, wherein one of the coupling main body and the coupling member has an elongated hole extending in the vertical direction, while the other one of the coupling main body and the coupling member has a shaft disposed in the elongated hole movably in the vertical direction, such that when the traveling of the elongated member by a fixed distance or more has occurred, the coupling member is caused to

undergo movement in the vertical direction relative to the coupling main body against the resiliency of the resilient member. In such a case, even if, for example, excessive traveling of the elongated member has occurred, the load on the plurality of slats, the raising and lowering mechanism, the link mechanisms, and the like can be damped by the resiliency of the resilient member.

[0027] In the window blind apparatus in accordance with the present invention, the coupling member may be mounted on the frame vertically movably.

ADVANTAGES OF THE INVENTION

[0028] According to the invention, it is possible to provide a window blind apparatus which makes it possible to transmit the operation of the raising and lowering mechanism with a simple configuration and allow the slats to be tilted and which makes it possible to render the apparatus compact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

Fig. 1 is an explanatory front view of an embodiment of the invention;

Fig. 2 is an explanatory vertical cross-sectional view, at the time of full opening of an opening, of the embodiment shown in Fig. 1;

Fig. 3 is an explanatory vertical cross-sectional view, at the time of full opening of the opening, of the embodiment shown in Fig. 1;

Fig. 4 is an explanatory vertical cross-sectional view, at the time of opening of the opening, of the embodiment shown in Fig. 1;

Fig. 5 is an explanatory vertical cross-sectional view, at the time of tilting of slats, of the embodiment shown in Fig. 1;

Fig. 6 is an explanatory vertical cross-sectional view, at the time of full closing of the opening, of the embodiment shown in Fig. 1;

Fig. 7 is an explanatory partially enlarged plan view of the embodiment shown in Fig. 1;

Fig. 8 is an explanatory partially enlarged plan view of the embodiment shown in Fig. 1;

Fig. 9 is an explanatory view of mainly a slat supporting member shown in Fig. 1;

Fig. 10 is an explanatory view of mainly a linearly movable member shown in Fig. 1;

Fig. 11 is an explanatory view of mainly a coupling member shown in Fig. 1;

Fig. 12 is an explanatory view of mainly a coupling main body shown in Fig. 1;

Parts (a), (b), and (c) of Fig. 13 are explanatory views of mainly a link member shown in Fig. 1;

Fig. 14 is an explanatory view of mainly a tilting means, at the time of full opening of the opening or at the time of opening of the opening, of the embod-

iment shown in Fig. 1;

Fig. 15 is an explanatory view of mainly the tilting means, at the time of tilting of slats, of the embodiment shown in Fig. 1;

Fig. 16 is an explanatory view of mainly the tilting means, at the time of full closing of the opening, of the embodiment shown in Fig. 1;

Fig. 17 is an explanatory view of mainly a coupling mechanism, at the time of full opening of the opening or at the time of opening of the opening, of the embodiment shown in Fig. 1;

Fig. 18 is an explanatory view of mainly the coupling mechanism, at the time of tilting of slats, of the embodiment shown in Fig. 1;

Fig. 19 is an explanatory view of mainly the coupling mechanism, at the time of full closing of the opening, of the embodiment shown in Fig. 1; and

Fig. 20 is an explanatory view concerning a modification of mainly the link member shown in Fig. 1.

MODE FOR CARRYING OUT THE INVENTION

[0030] Next, a more detailed description will be given of the mode for carrying out the invention on the basis of the preferred embodiment illustrated in the drawings. It should be noted that the present invention is not limited to the embodiment.

[0031] In Figs. 1 to 19, a window blind apparatus 1 in accordance with this embodiment is comprised of a frame 3 defining an opening 2; a plurality of slats 4 juxtaposed to each other in the opening 2 in a direction Z which is a vertical direction; a pair of link mechanisms 5 for linking the plurality of slats 4 to each other; a raising and lowering mechanism 6 for raising and lowering the plurality of slats 4, starting with a lowermost slat 4a among the plurality of slats 4; and a tilting means 7 which is disposed on a rear side of an uppermost slat 4b among the plurality of slats 4 in a direction X which is a front-back direction perpendicular to the direction Z, and which tilts the plurality of slats 4 on the basis of the raising and lowering of the slats 4 by the raising and lowering mechanism 6.

[0032] As shown in Fig. 1, the frame 3 includes a pair of vertical frames 11 and 12 provided uprightly in such a manner as to extend in the direction Z and opposing each other in a direction Y which is a lateral direction perpendicular to the direction X and the direction Z; an upper frame 13 bridging upper portions of the pair of vertical frames 11 and 12 and extending in the direction Y; and a lower frame 14 bridging lower portions of the pair of vertical frames 11 and 12 and extending in the direction Y.

[0033] As shown in Figs. 7 and 8, the vertical frame 11 includes an outer frame 15 extending in the direction Z and an inner frame 16 which is covered by the outer frame 15 and is detachably mounted on the outer frame 15 in such a manner as to extend in the direction Z.

[0034] The inner frame 16 has a pair of guide grooves 17 and 18 for guiding a chain 52 of the raising and lowering mechanism 6 in the direction Z and a guide groove

19 for guiding a mounting means 102 of a slat supporting member 101 in the direction Z. The outer frame 15 and the inner frame 16 form a guide groove 20 for guiding a rear edge portion 32 of each of the slats 4 in the direction Z in cooperation with each other. Each of the guide grooves 17 to 20 extends in the direction Z, the guide groove 18 being disposed in the rear of the guide groove 17, the guide groove 18 being disposed in the rear of the guide groove 19, the guide groove 19 being disposed in the rear of the guide groove 20. As shown in Fig. 7, a link member 34 is disposed in a space defined by the outer frame 15 and the inner frame 16 and extending in the direction Z on the front side. Since the vertical frame 12 is formed in the same way as the vertical frame 11, a detailed description thereof will be omitted.

[0035] The number of the slats 4 is appropriately set according to the dimensions of such as the opening and the window of the building in which the window blind apparatus 1 is installed. Each of the slats 4 includes a slat body 21 which is elongated in the direction Y and is formed in an upwardly protruding shape, as shown in Fig. 4, and a pair of supports 23 attached to respective ones of both end portions 22 in the direction Y of the slat body 21 to support the both end portions 22, respectively. Since the pair of supports 23 are formed in a mutually similar manner, a detailed description will be given hereinafter of one of the pair of supports 23, and as for the other one of the pair of supports 23, a detailed description thereof will be omitted.

[0036] The support 23 may be attached to the end portion 22 of the slat body 21 by means of bolts or the like, or may be detachably attached, for example, to the end portion 22 of the slat body 21 in a snap-fitting manner through projection and recess constituted by a fitting means 24 or may be formed integrally on the slat body 21.

[0037] The plurality of supports 23 are formed of a synthetic resin and are formed in an upwardly protruding shape, as shown in Fig. 4. As shown in Fig. 7, a shaft 27 serving as a supported portion, which is supported by a linearly movable member 111, is mounted on a support 23b attached to the end portion 22 of the slat body 21 of the uppermost slat 4b among the plurality of supports 23, in such a manner as to extend in the direction Y toward the slat body 21 side. The support 23b is provided with a blocking plate part 25 formed in such a manner as to extend in the direction Y toward the vertical frame 11 so as to prevent the rotation of the slat 4b in the direction of opening the opening by more than a predetermined amount by coming into contact with an upper edge of the slat supporting member 101 extending in the direction X at the time of full opening of the opening shown in Figs. 2 and 3 and at the time of opening of the opening shown in Fig. 4. An end portion 26 of the blocking plate portion 25 on the vertical frame 11 side in the direction Y is bent downwardly, and the link member 34 is connected thereto. A shaft 28 serving as a supported portion supported by the slat supporting member 101 is mounted on the support 23b, and the shaft 28 is located forwardly of the

center of gravity of the slat 4b.

[0038] The link mechanism 5 includes a foldable link member 33 which connects front edge portions 31 of the plurality of slats 4 to each other in the direction Z and a foldable link member 34 which is disposed rearwardly of the link member 33 in the direction X and connects the rear edge portions 32 of the plurality of slats 4 to each other in the direction Z. It should be noted that although the link mechanism 5 is provided for each of the vertical frame 11 side and the vertical frame 12 side, since they are formed in a mutually similar manner, a detailed description will be given hereinafter of the link mechanism 5 on the vertical frame 11 side.

[0039] Since the link members 33 and 34 are formed in a mutually similar manner, a detailed description will be given hereinafter of the link member 33, and, as for the link member 34, the reference numeral will be allotted appropriately in the drawings, and a detailed description thereof will be omitted.

[0040] As shown in parts (a) to (c) of Fig. 13, the link member 33 has one continuous flexible cord-like member 37 which is rotatably connected at an upper end 35 thereof to the end portion 22 in the direction Y of the uppermost slat 4b by means of a connector 39 and is rotatably connected at a lower end 36 thereof to the end portion 22 in the direction Y of the lowermost slat 4a by means of a connector 40, as well as a plurality of rotational connectors 38 which are secured to the cord-like member 37 and are respectively rotatably connected to the end portions 22 in the direction Y of the plurality of slats 4 excluding the uppermost slat 4b and the lowermost slat 4a. An upper end 41 of the rotational connector 38 at the time of opening of the opening is rotatably connected to a lower end 42 of another rotational connector 38 upwardly adjacent to that rotational connector 38, while the lower end 42 of the rotational connector 38 at the time of opening of the opening is rotatably connected to the upper end 41 of another rotational connector 38 downwardly adjacent to that rotational connector 38.

[0041] The cord-like member 37, which has a cross-sectionally circular shape and is formed of a fabric of a synthetic resin yarn, is passed through the plurality of rotational connectors 38, is secured at the upper end 35 thereof to the connector 39, and is secured at the lower end 36 thereof to the connector 40. The plurality of rotational connectors 38 are secured to the cord-like member 37 such that, when the cord-like member 37 is being extended in the direction Z, as shown in Figs. 3 to 5, the plurality of rotational connectors 38 are respectively arranged at equal intervals therebetween, and the interval between the connector 39 and the rotational connector 38 adjacent thereto in the direction Z and the interval between the connector 40 and the rotational connector 38 adjacent thereto in the direction Z become equal to the interval between adjacent ones of the rotational connectors 38 in the direction Z.

[0042] Each of the plurality of rotational connectors 38 has a rotational connector body 45 extending in a direc-

tion perpendicular to the direction Y and a connecting portion 46 which is rotatably connected to the respective support 23 of a corresponding slat 4 at an intermediate portion of the rotational connector body 45 between an upper end 41 thereof and a lower end 42 thereof when the opening is open.

[0043] The connecting portion 46 projects from the rotational connector body 45 in the direction Y, and has a truncated conical portion 47 disposed at a tip thereof, a small-diameter cylindrical portion 48 adjacent to the truncated conical portion 47, and a cylindrical portion 49 which has a larger diameter than the small-diameter cylindrical portion 48 and has the same diameter as the maximum diameter of the truncated conical portion 47. The connecting portion 46 is inserted, starting with the truncated conical portion 47, into a fitting hole formed in the support 23 serving as the end portion 22 in the direction Y of each corresponding slat 4, and is detachably connected to that support 23 in a snap-fitting manner.

[0044] The raising and lowering mechanism 6 disposed rearwardly of the plurality of slats 4 in the direction X includes a rotating body, i.e., a sprocket wheel 51 in this embodiment, which is rotatably supported by the inner frame 16; a flexible elongated member, i.e., an ended chain 52 in this embodiment, which is wound around the sprocket wheel 51 so as to travel on one side in an A direction in the direction Z and to travel on the other side in a B direction which is an opposite direction to the A direction; a coupling mechanism 53 for coupling one side of the chain 52 to the lowermost slat 4a to allow the traveling of the chain 52 on one side to be transmitted to the plurality of slats 4; and a traveling means (not shown) for causing the chain 52 to travel in the A direction and the B direction. The traveling means has an electric motor connected to the sprocket wheel 51 through a rotating shaft 54, or a rotatively operating handle. The traveling means is adapted to rotate the sprocket wheel 51 by the operation of the electric motor or the rotating operation of the rotatively operating handle to thereby cause the chain 52 to travel. It should be noted that a chain presser 55 which is mounted on the inner frame 16 is disposed around the sprocket wheel 51 to prevent unnecessary deflection of the chain 52. It should also be noted that the raising and lowering mechanism 6 is provided for both the vertical frame 11 side and the vertical frame 12 side, but since they are constructed in a mutually similar manner, a detailed description will be given hereinafter of the raising and lowering mechanism 6 on the vertical frame 11 side. The sprocket wheel 51 on the vertical frame 11 side is coupled to the corresponding sprocket wheel on the vertical frame 12 side through the rotating shaft 54. In addition, the bidirectional raising and lowering mechanisms 6 on the vertical frame 11 side and the vertical frame 12 side use the traveling means in common.

[0045] In order to allow the traveling of the chain 52 to be guided in the direction Z, the chain 52 is disposed in the guide grooves 17 and 18 formed in the inner frame 16 and extending in the direction Z, so as to prevent un-

necessary deflection thereof. An end portion 56 of the chain 52 is guided by the guide groove 17 and is coupled to the lowermost slat 4a by means of the coupling mechanism 53. An abutment member 119 is mounted on an end portion 57 of the chain 52 which is located rearwardly of the end portion 56 of the chain 52 and is guided by the guide groove 18.

[0046] As the chain 52 is made to travel in the A direction, the end portion 56 thereof is lowered, and the end portion 57 thereof is raised in the B direction, whereas as the chain 52 is made to travel in the B direction, the end portion 56 is raised, and the end portion 57 is lowered in the A direction. The guide grooves 17 and 18 extending from the upper end to the lower end of the vertical frame 11 are partially removed at the portion where the chain presser 55 is disposed, and the chain presser 55 is disposed at that portion where the guide grooves 17 and 18 are removed so as to be able to press the chain 52 around the sprocket wheel 51. The sprocket wheel 51 and the rotating shaft 54 are disposed rearwardly of the plurality of slats 4 in the direction X.

[0047] The coupling mechanism 53 includes a coupling member 61 mounted on the frame 3 movably in the direction Z and coupled to the end portion 56 of the chain 52; a coupling main body 62 coupled to the coupling member 61 movably in the direction Z by a predetermined amount; a coil spring 63 serving as a resilient member interposed between the coupling member 61 and the coupling main body 62 in the direction Z; a coupling arm 66 which is rotatably coupled at an one end 64 thereof to the lowermost slat 4a and is rotatably coupled at another end 65 thereof to the coupling main body 62; a hampering piece 67 which is integrally formed with the other end 65 of the coupling arm 66 and is brought into contact with the coupling main body 62 so as to hamper the rotation of the coupling arm 66 by more than a predetermined amount which occurs when the coupling main body 62 is raised with respect to the lowermost slat 4a by the traveling of the chain 52 in the B direction; and a seat plate 68 which is mounted on the coupling main body 62 in such manner as to extend in the direction Y and on which the lowermost slat 4a is seated.

[0048] As shown in Fig. 11, the coupling member 61 has a plate-like body 71 to which the end portion 56 of the chain 52 is secured; a pair of rolling rollers 72 and 73 serving as guide members which are mounted on the plate-like body 71 and are disposed in the guide groove 17 movably in the direction Z; a pair of shafts 74 and 75 mounted on the plate-like body 71 and coupled to the coupling main body 62; and a rod-like holding portion 76 formed integrally with the plate-like body 71 to hold one end of the coil spring 63.

[0049] As shown in Fig. 12, the coupling member 62 has a plate-like body 81; an elongated hole 82 formed in the plate-like body 81 in such a manner as to extend in the direction Z; a rolling roller 83 serving as a guide member which is mounted on the plate-like body 81 and is disposed in the guide groove 19 movably in the direction

Z; and a rod-like holding portion 84 formed integrally with the plate-like body 81 to hold the other end of the coil spring 63. The shafts 74 and 75 are disposed in the elongated hole 82 movably in the direction Z, and the coupling main body 62 is coupled to the coupling member 61 by means of the shafts 74 and 75 inserted in the elongated hole 82 thereof. The coupling main body 62 is urged by the resiliency of the coil spring 63 so as to move away from the coupling member 61 in the direction Z. As a result of the fact that the coupling main body 62 is thus urged, the shaft 74 is disposed in an upper end portion of the elongated hole 82 of the coupling main body 62. The movement of the coupling member 61 in the direction Z is transmitted to the coupling main body 63 through the coil spring 63. When the traveling of the chain 52 in the A direction by more than a fixed amount, the coupling main body 62 is adapted to undergo relative movement in the B direction with respect to the coupling member 61 against the resiliency of the coil spring 63.

[0050] The one end 64 of the coupling arm 66 is rotatably coupled to the lowermost slat 4a forwardly of the center of gravity of the slat 4.

[0051] The seat plate 68 has a seat plate portion 85 which extends in the direction X and on which the lowermost slat 4a is seated when the opening is open, as well as a cover plate portion 88 which is connected to a rear edge 86 of the seat plate portion 85 in such a manner as to extend in the direction Z and covers an underside part 87 underneath the lowermost slat 4a when the opening is closed.

[0052] As the chain 52 is made to travel in the A and B directions, the coupling mechanism 53 is moved in the direction Z while being guided by the rolling rollers 72 and 73 moving vertically in the guide groove 17 and by the rolling roller 83 moving vertically in the guide groove 19, and the coupling mechanism 53 is adapted to move the lowermost slat 4a in the direction Z by this movement.

[0053] With the above-described raising and lowering mechanism 6, the sprocket wheel 51 is rotated by the traveling means through the rotating shaft 54, which rotation causes the chain 52 to travel in the A direction, and the lowermost slat 4a is lowered through the coupling mechanism 53 by this traveling. Thus, the plurality of slats 4 are lowered, starting with the lowermost slat 4a. On the other hand, the sprocket wheel 51 is reversely rotated by the traveling means through the rotating shaft 54, which reverse rotation causes the chain 52 to travel in the B direction, and the lowermost slat 4a is raised through the coupling mechanism 53 by this traveling. Thus, the plurality of slats 4 are raised, starting with the lowermost slat 4a.

[0054] The tilting means 7 includes a slat supporting mechanism 91 and a linearly moving mechanism 92, as shown in Figs. 9 and 10 and Figs. 14 to 16.

[0055] The slat supporting mechanism 91 includes the slat supporting member 101 for supporting the shaft 28, which serves as the supported portion for the uppermost slat 4b of the plurality of slats 4, rotatably and movably

in the direction X, the mounting means 102 for mounting the slat supporting member 101 to the frame 3, and a pair of shafts 108 and 109 mounted on the slat supporting member 101 and connected to the linearly movable member 111 movably in the direction Z. The shafts 108 and 109 oppose each other in the direction Z.

[0056] The slat supporting member 101 includes a plate-like main body 103 projecting forwardly from a mounted position thereof where it is mounted on the inner frame 16 by means of the mounting means 102 in the direction X, as well as an elongated hole or a slit, i.e., an elongated hole 104 in this embodiment, which is provided in the main body 103 in such a manner as to extend in the direction X and in which the shaft 28 of the uppermost slat 4b is disposed movably in the direction X. The elongated hole 104 is inclined forwardly downwardly.

[0057] The shaft 28 of the slat 4b, which is inserted in the elongated hole 104, is movable in the direction X along the elongated hole 104, and the movement of the shaft 28 in the direction X relative to the slat supporting member 101, accompanying the linear movement of the rear edge portion 32 of the slat 4b in the direction Z, is allowed, while a movement thereof in the direction Z relative to the slat supporting member 101 is inhibited by an abutment thereof against the main body 103 in which the elongated hole 104 is defined. Additionally, the shaft 28 is rotatably disposed in the elongated hole 104.

[0058] As the shaft 28 is disposed in the elongated hole 104, the slat supporting member 101 which is mounted on the vertical frame 11 by the mounting means 102 supports the slat 4b rotatably and movably in the direction X.

[0059] The mounting means 102 has a pair of rolling rollers 105 and 106 serving as attaching members for fitting the slat supporting member 101 in the guide groove 19 of the inner frame 16 linearly movably in the direction Z, as well as a stopper 107 for stopping the lowering of the slat supporting member 101 by more than a predetermined amount relative to the vertical frame 11 by abutting against the slat supporting member 101. The stopper 107, which is provided in the guide groove 19 of the inner frame 16, abuts against the rolling roller 106 when the slat supporting member 101 is lowered to a predetermined position to stop the lowering of the slat supporting member 101 by this abutment. The above-described mounting means 102 mounts the slat supporting member 101 movably in the direction Z by the pair of rolling rollers 105 and 106, and limits the movement of the slat supporting member 101 in the direction Z to a predetermined range by the stopper 107.

[0060] The linearly moving mechanism 92 includes the linearly movable member 111 which rotatably supports the shaft 27 disposed at the rear edge portion 32 of the slat 4b located rearwardly of the shaft 28 of the slat 4b, is linearly movable in the direction Z, and in a linear movement thereof in the direction Z causes the slat 4b to tilt by the relative displacement of the rear edge portion 32 in the direction Z relative to the shaft 28, as well as a transmitting means 112 for transmitting the traveling of

the end portion 57 of the chain 52 to the linearly movable member 111 so as to linearly move the linearly movable member 111 in the direction Z on the basis of the raising and lowering of the slats 4 by the raising and lowering mechanism 6.

[0061] As shown in Fig. 10, the linearly movable member 111 includes a plate-like main body 113 extending in the direction Z; an elongated hole or a slit, i.e., an elongated hole 114 in this embodiment, which is formed in the main body 113 in such a manner as to extend in the direction Z, and in which the shafts 108 and 109 are fitted movably in the direction Z; a fitting portion 115 constituted by a recess which is integrally formed with the main body 113 on the forward side, and in which the shaft 27 of the slat 4b is detachably fitted rotatably; a plate-like rearward projecting portion 116 which is integrally formed on the main body 113 on the rearward side and abuts against the abutment member 119; and a rolling roller 118 which is mounted on the rearward projecting portion 116 and is disposed movably in the direction Z in a groove 117 formed in the inner frame 16 between the guide grooves 17 and 18 in such a manner as to extend in the direction Z. The linearly movable member 111 is connected to the slat supporting member 101 by means of the shafts 108 and 109 so as to undergo relative displacement by a predetermined amount in the direction Z relative to the slat supporting member 101.

[0062] The transmitting means 112 has the abutment member 119 which is mounted on the end portion 57 of the chain 52 and which, in order to transmit the traveling of the end portion 57 of the chain 52 in the A and B directions to the linearly movable member 111, abuts against the rearward projecting portion 116 of the linearly movable member 111 in that traveling.

[0063] The abutment member 119 is arranged such that, as the end portion 57 of the chain 52 travels in the B direction, the abutment member 119 approaches the linearly movable member 111 and abuts against it, as shown in Fig. 4, and, as the end portion 57 further travels in the B direction, the abutment member 119 linearly moves the linearly movable member 111 upwardly, as shown in Figs. 5 and 6, whereas, as the end portion 57 of the chain 52 travels in the A direction, the abutment member 119 allows the downward linear movement of the linearly movable member 111 based on the self weight of the slat 4 and the like, and, as the end portion 57 further travels in the A direction, the abutment member 119 linearly moves away from the linearly movable member 111, as shown in Fig. 2.

[0064] In the opening fully-open state of the window blind apparatus 1 in which the opening 2 is fully open, as shown in Figs. 2 and 3, the plurality of slats 4 are superposed on each other in a state in which they extend in the direction X (horizontally extended state) and are bundled in the upper portion of the frame 3; the link members 33 and 34 are folded; the slat supporting member 101 and the linearly movable member 111 are in a state of being lifted up by the slat 4b, the slat supporting member

101 being in state in which it has been moved upwardly relative to the linearly movable member 111, as shown in Fig. 14; and the shaft 28 is disposed upwardly and forwardly of the shaft 27 and is disposed on the forward end side of the elongated hole 104, as shown in Fig. 14. Further, as shown in Fig. 17, the rear edge portion 32 of the slat 4a is seated on the seat plate portion 85 of the seat plate 68, the one end 64 of the coupling arm 66 is in a state of being located forwardly of the other end 65 thereof, and the hampering piece 67 prevents the rotation of the coupling arm 66. The other slats 4 are stacked above the slat 4a.

[0065] In the opening closed state of the window blind apparatus 1 in which the opening 2 is closed, as shown in Fig. 6, the plurality of slats 4 are in a state in which they are extended in the direction Z (in a vertically extended state), such that the front edge portion 31 is located downwardly of the rear edge portion 32, and the front edge portion 31 of the uppermost slat 4b abuts against the rear edge portion 32 of the slat 4 adjacent to that slat 4b in the direction Z, while the rear edge portion 32 of the lowermost slat 4a abuts against the front edge portion 31 of the slat 4 adjacent to that slat 4a in the direction Z. Further, the front edge portion 31 of each of the slats 4 between the slats 4a and 4b abuts against the rear edge portion 32 of the slat 4 adjacent thereto in the direction Z, while the rear edge portion 32 of each of these slats 4 abuts against the front edge portion 31 of the slat 4 adjacent thereto in the direction Z. Furthermore, the link members 33 and 34 are extended in the direction Z, the slat supporting member 101 is lowered by receiving the load of the plurality of slats 4 and the link mechanism 5, the rolling roller 106 is disposed at the position where it abuts against the stopper 107, and the linearly movable member 111 is disposed at the highest position relative to the slat supporting member 101 in the direction Z, as shown in Fig. 16. In addition, as shown in Fig. 19, the slat 4a is separated from the seat plate portion 85 of the seat plate 68, the coupling arm 66 is rotated with the one end 64 thereof located upwardly relative to the other end 65 thereof, the hampering piece 67 is separated from the coupling main body 62, and the space between the seat plate portion 85, on the one hand, and the slat 4a and the front edge portion 31 thereof, on the other hand, i.e., the underside part 87 underneath the slat 4a, is covered by the cover plate portion 88 so as to be screened in the direction X. In the state shown in Fig. 19, the cover plate portion 88 may be disposed in such a manner as to come into contact with the front edge portion 31 of the slat 4a.

[0066] Next, referring to the drawings, a detailed description will be given of the operation concerning the closing of the opening 2 by the window blind apparatus 1 in accordance with this embodiment.

[0067] First, in the window blind apparatus 1 in the opening fully-open state shown in Figs. 2 and 3, the sprocket wheel 51 is rotated by the rotation of the rotating shaft 54, thereby causing the end portion 56 of the chain 52 to travel in the A direction. As a result of the traveling

of the end portion 56 of the chain 52 in the A direction, the lowermost slat 4a connected to the end portion 56 of the chain 52 through the coupling mechanism 53 and the plurality of slats 4 connected to that slat 4a through the link mechanism 5 are lowered. In conjunction with the lowering of the plurality of slats 4, the slat supporting member 101 is lowered until the rolling roller 106 fitted to the slat supporting member 101 abuts against the stopper 107 and the lowering thereof is stopped. The linearly movable member 111 is lowered in conjunction with the lowering of the slat supporting member 101, and the lowering thereof is stopped in conjunction with the stopping of the lowering of the slat supporting member 101 is stopped.

[0068] After the lowering of the slat supporting member 101 is stopped by the stopper 107, as the end portion 56 of the chain 52 is further caused to travel in the A direction, the plurality of slats 4 are lowered, and the link members 33 and 34 are extended and assume the opening open state shown in Fig. 4. The abutment member 119 mounted on the end portion 57 traveling in the B direction in conjunction with the traveling of the end portion 56 of the chain 52 in the A direction abuts against the rearward projecting portion 116 of the linearly movable member 111 simultaneously with the abutment of the rolling roller 106 against the stopper 107.

[0069] In the window blind apparatus 1 in the opening open state shown in Fig. 4, as the end portion 56 of the chain 52 is further caused to travel in the A direction, the coupling main body 62 is lowered, and, as shown in Fig. 18, the coupling arm 66 is caused to undergo rotation in the direction in which the one end 64 thereof is positioned above the other end 65 thereof, thereby drawing the front edge portion 31 of the slat 4a closer to the coupling main body 62 side. In conjunction with further traveling of the end portion 56 of the chain 52, the abutment member 119 mounted on the end portion 57 traveling in the B direction is raised to linearly move the linearly movable member 111 upwardly, which linear movement causes the slat supporting member 101 to undergo relative upward displacement in the direction Z, as shown in Fig. 15. This displacement causes the shaft 27 to be positioned upwardly of the shaft 28, thereby tilting the slat 4b in the direction of closing the opening. The tilting of the slat 4b is transmitted to all the plurality of slats 4 through the link members 33 and 34, so that the plurality of slats 4 are tilted, as shown in Fig. 5.

[0070] In the window blind apparatus 1 with the slats 4 set in the tilted state, as shown in Fig. 5, when the end portion 56 of the chain 52 is further caused to travel in the A direction, the plurality of slats 4 are tilted in the same way as described above, thus fully closing the opening 2, as shown in Fig. 6. In the window blind apparatus 1 in the opening fully-closed state, as shown in Fig. 6, the shaft 28 is disposed forwardly below the shaft 27, and is disposed at the rear end side of the elongated hole 104, as shown in Fig. 16.

[0071] In addition, the window blind apparatus 1 in the

opening fully-closed state, as shown in Figs. 1 and 6, is operated in the reverse order by the traveling of the end portion 56 of the chain 52 in the B direction, whereby the linearly movable member 111 is lowered by the self weight of the slats 4 and the like and is caused to undergo relative downward displacement relative to the slat supporting member 101 to cause the slats 4 to tilt in the opposite direction, and after undergoing the tilted state shown in Fig. 5, the slats 4 are set in the horizontal state, as shown in Fig. 4. As the end portion 56 of the chain 52 is further caused to travel in the B direction, the slats 4 are sequentially lifted up from below by the seat plate portion 85, the slat supporting member 101 and the linearly movable member 111 are also raised by means of the slat 4b, thereby allowing the window blind apparatus 1 to be set in the opening fully-open state shown in Figs. 2 and 3. During the raising of the slats 4, each rotational connector 38 is caused to rotate, so that the upper end 41 thereof moves in one of the forward direction and the rearward direction in the direction X, which movement causes the lower end 42 of another rotational connector 38 adjacent to that rotational connector 38 in the direction Z to move in the other one of forward direction and the rearward direction in the direction X. Thus, the link members 33 and 34 are sequentially folded from below, and finally assume the folded state shown in Fig. 3.

[0072] According to the window blind apparatus 1 in accordance with this embodiment, the window blind apparatus 1 is comprised of: the frame 3 defining the opening 2; the plurality of slats 4 juxtaposed to each other in the opening 2 in the direction Z; the pair of link mechanisms 5 for linking the plurality of slats 4 to each other; the raising and lowering mechanism 6 for raising and lowering the plurality of slats 4, starting with the lowermost slat 4a; and the tilting means 7 which is disposed on the rear side of the slat 4 and tilts the plurality of slats 4 on the basis of the raising and lowering of the slat 4a by the raising and lowering mechanism 6. The raising and lowering mechanism 6 includes the sprocket wheel 51 serving as a rotating body rotatably supported by the frame 3; the chain 52 serving as a flexible elongated member wound around the sprocket wheel 51 so as to travel in the direction Z on one side and to travel in the opposite direction on the other side; and the coupling mechanism 53 for coupling one side of the chain 52 to the lowermost slat 4a to allow the traveling of the chain 52 on one side to be transmitted to the plurality of slats 4. The tilting means 7 includes: the slat supporting mechanism 91 including the slat supporting member 101 for supporting the shaft 28, which serves as the supported portion of the uppermost slat 4b of the plurality of slats 4, rotatably and movably in the direction X, and the mounting means 102 for mounting the slat supporting member 101 to the frame 3; and the linearly moving mechanism 92 including the linearly movable member 111 which rotatably supports the rear edge portion 32 of the uppermost slat 4b located rearwardly of the shaft 28, is linearly movable in the direction Z, and in the linear

movement thereof in the direction Z causes the slat 4 to tilt by the relative displacement of the rear edge portion 32 in the direction Z relative to the shaft 28, as well as the transmitting means 112 for transmitting the traveling of the chain 52 on the other side to the linearly movable member 111 so as to linearly move the linearly movable member 111 in the direction Z on the basis of the raising and lowering of the slats 4 by the raising and lowering mechanism 6. Since the transmitting means 112 has the abutment member 119 which is mounted on the other side of the chain 52 and which, in order to transmit the traveling on the other side of the chain 52 in the direction Z to the linearly movable member 111, abuts against the linearly movable member 111 in that traveling, the operation of the raising and lowering mechanism 6 can be transmitted by a simple configuration to allow the slats 4 to be tilted. Moreover, it is possible to eliminate the need to install a rack-and-pinion mechanism or the like separately from the raising and lowering mechanism 6, so that it is possible to render the apparatus compact.

[0073] According to the window blind apparatus 1, since the shaft 28 of the uppermost slat 4b which is supported by the slat supporting member 101 is located forwardly of the center of gravity of the slat, a rotational force is produced in the slat 4b at the time of opening the opening due to the own weight thereof, with the result that the opening open state can be stabilized without needing to install a complex mechanism.

[0074] According to the window blind apparatus 1, the slat supporting member 101 is mounted on the frame 3 linearly movably in the direction Z, and the frame 3 is provided with the stopper 107 for stopping the lowering of the slat supporting member 101 by more than a predetermined amount by abutting against the slat supporting member 101. Therefore, the plurality of slats 4 which are superposed on each other on the basis of the operation of the raising and lowering mechanism 6 can be accommodated in an upper portion of the frame 3, which makes it possible to enlarge the opening 2 and make effective use of the upper space of the frame 3, thereby making it possible to render the apparatus compact.

[0075] According to the window blind apparatus 1, the link mechanism 5 includes the link member 33 for connecting the plurality of slats 4 to each other and the link member 34 disposed rearwardly of the link member 33 and connecting the plurality of slats 4 to each other. At least one of the link members 33 and 34, or each of them in this embodiment, has one continuous flexible cord-like member 37 which is rotatably connected at the upper end 35 thereof to the end portion 22 in the direction Y of the uppermost slat 4b and is rotatably connected at the lower end 36 thereof to the end portion 22 in the direction Y of the lowermost slat 4a, as well as the plurality of rotational connectors 38 which are secured to the cord-like member 37 and are respectively rotatably connected to the end portions 22 in the direction Y of the plurality of slats 4 excluding the slats 4a and 4b. The upper end 41 of the rotational connector 38 at the time of opening

of the opening is rotatably connected to the lower end 42 of another rotational connector 38 upwardly adjacent to that rotational connector 38, while the lower end 42 of the rotational connector 38 at the time of opening of the opening is rotatably connected to the upper end 41 of another rotational connector 38 downwardly adjacent to that rotational connector 38. Therefore, when the plurality of slats 4 are raised on the basis of the operation of the raising and lowering mechanism 6, one of the set of the upper ends 41 and the set of the lower ends 42 of the plurality of rotational connectors 38 during the opening of the opening are located on one side in the direction X, and the other one of the set of the upper ends 41 and the set of the lower ends 42 are located on the other side in the direction X, with the result that the cord-like member 37 can be folded with regularity. Hence, the link mechanism 5 can be configured simply and with light weight, and it is possible to secure stable operation of the apparatus.

[0076] According to the window blind apparatus 1, the frame 3 has the pair of vertical frames 11 and 12 which oppose each other in the direction Y, at least one of the pair of vertical frames 11 and 12 has the outer frame 15 and the inner frame 16 which is covered by the outer frame 15 and is detachably mounted on the outer frame 15, and the inner frame 16 has the guide grooves 17, 18, and 19 for guiding the chain 52 and the mounting means 102 of the slat supporting member 101 in the direction Z. Therefore, the operation of mounting the plurality of slats 4 and the maintenance and inspection of the link mechanisms 5 and the like can be carried out simply and speedily.

[0077] According to the window blind apparatus 1, the coupling mechanism 53 includes the coupling main body 62 coupled to the chain 52, the coupling arm 66 which is rotatably coupled at the one end 64 thereof to the lowermost slat 4a and is rotatably coupled at the other end 65 thereof to the coupling main body 62, and the seat plate 68 which is mounted on the coupling main body 62 in such manner as to extend in the direction Y and on which the lowermost slat 4a is seated. The seat plate 68 has the seat plate portion 85 which extends in the direction X and on which the lowermost slat 4b is seated when the opening is open, as well as the cover plate portion 88 which is connected to the rear edge 86 of the seat plate portion 85 in such a manner as to extend in the direction Z and covers the underside part 87 underneath the lowermost slat 4a when the opening is closed. Therefore, at the time when the opening 2 is opened, the lowermost slat 4a can be seated on the seat plate portion 85, and the other plurality of slats 4 can be stacked on that lowermost slat 4a, thereby making it possible to accommodate the plurality of slats 4 compactly; meanwhile, at the time when the opening 2 is closed, the underside part 87 underneath the lowermost slat 4a can be covered by the cover plate portion 88 of the seat plate 85 which has been relatively lowered with respect to the lowermost slat 4a by the operation of the raising and lowering mechanism

6, thereby making it possible to obtain a preferable opening closed state.

[0078] According to the window blind apparatus 1, the one end 64 of the coupling arm 66 may be rotatably coupled to the lowermost slat 4a forwardly of the center of gravity of the slat 4, in which case a rotational force can be produced in the slat 4a at the time of opening the opening due to the own weight thereof, so that it is possible to secure more stable operation of the apparatus.

[0079] According to the window blind apparatus 1, the coupling mechanism 53 further includes the coupling member 61 for coupling the coupling main body 62 to the chain 52 and the coil spring 63 serving as the resilient member interposed between the coupling main body 62 and the coupling member 61 in the direction Z, wherein one of the coupling main body 62 and the coupling member 61, i.e., the coupling main body 62 in this embodiment, has the elongated hole 82 extending in the direction Z, while the other one of the coupling main body 62 and the coupling member 61, i.e., the coupling member 61 in this embodiment, has the shafts 74 and 75 disposed in that elongated hole 82 movably in the direction Z. The arrangement provided is such that when the traveling of the chain 52 by a fixed distance or more has occurred, the coupling member 61 is caused to undergo movement in the direction Z relative to the coupling main body 62 against the resiliency of the coil spring 63, so that even if, for example, excessive traveling of the chain 52 has occurred, the load on the plurality of slats 4, the raising and lowering mechanism 6, the link mechanisms 5, and the like can be damped by the resiliency of the coil spring 63.

[0080] The window blind apparatus 1 in accordance with this embodiment may be further comprised of an urging means (not shown) for urging the uppermost slat 4b in the tilting direction when the opening 2 is opened, and the urging means may include a resiliently urging member constituted by such as a coil spring for urging the linearly movable member 111 in the direction Z. Such a resiliently urging member may be connected, for example, to the linearly movable member 111 and the frame 3 so as to resiliently urge the linearly movable member 111 in the direction Z.

[0081] The link members 33 and 34 of the window blind apparatus 1 in accordance with this embodiment include the cord-like member 37 and the plurality of rotational connectors 38. However, as shown in Fig. 20, the link members 33 and 34 may include in substitution thereof a plurality of rotational connectors 128 which are respectively rotatably connected to the end portions 22 in the direction Y of the plurality of slats 4 excluding the uppermost slat 4b and the lowermost slat 4a, as well as a plurality of flexible cord-like members 127 which connect an upper end 131 of the rotational connector 128 to a lower end 132 of another rotational connector 128 upwardly adjacent to that rotational connector 128 at the time of opening of the opening, and connect the lower end 132 of the rotational connector 128 to the upper end 131 of

another rotational connector 128 downwardly adjacent to that rotational connector 128 at the time of opening of the opening. The cord-like member 127, which is secured at the one end 125 thereof to the upper end 131 at the time of opening of the opening of the rotational connector 128 connected to the slat 4 adjacent to the uppermost slat 4b in the direction Z, may be rotatably connected at the other end 126 thereof to the uppermost slat 4b through the connector 39, while the cord-like member 127, which is secured at the other end 126 thereof to the lower end 132 at the time of opening of the opening of the rotational connector 128 connected to the slat 4 adjacent to the lowermost slat 4a in the direction Z, may be rotatably connected at the one end 125 thereof to the lowermost slat 4a. In such a case, when the plurality of slats 4 are raised on the basis of the operation of the raising and lowering mechanism 6, one of the set of the upper ends 131 and the set of the lower ends 132 of the plurality of rotational connectors 128 during the opening of the opening are located on one side in the direction X, and the other one of the set of the upper ends 131 and the set of the lower ends 132 are located on the other side in the direction X, with the result that the cord-like members 127 can be folded with regularity. Hence, the link mechanism 5 can be configured simply and with light weight, and it is possible to secure stable operation of the apparatus.

[0082] A hole or a recess 133 into which each of the end portions 125 and 126 of the cord-like member 127 is inserted and a retaining pawl 134 for retaining each of the end portions 125 and 126 of the cord-like member 127 to prevent the respective one of the end portions 125 and 126 of the cord-like member 127 inserted in the hole or the recess 133 from coming off may be formed in each of the both ends 131 and 132 of the plurality of rotational connectors 128, in which case it is possible to attain improvement of ease in assembling the link members 33 and 34. In addition, an enlarged portion 135 may be formed at each of the end portions 125 and 126 of the cord-like member 127, in which case it is possible to more reliably prevent the coming off of the end portions 125 and 126 of the cord-like member 127 retained by the retaining pawl 134.

DESCRIPTION OF REFERENCE NUMERALS AND SIGNS

[0083]

1:	window blind apparatus	
2:	opening	
3:	frame	
4, 4a, 4b:	slat	
5:	link mechanism	
6:	raising and lowering mechanism	
7:	tilting mechanism	
27, 28:	shaft	
91:	slat supporting mechanism	

92:	linearly moving mechanism
101:	slat supporting member
102:	mounting means
107:	stopper
111:	linearly movable member
112:	transmitting means
119:	abutment member

10 Claims

1. A window blind apparatus comprising:

a frame defining an opening;
 a plurality of slats juxtaposed to each other in the opening in a vertical direction;
 a pair of link mechanisms for linking said plurality of slats to each other;
 a raising and lowering mechanism for raising and lowering said plurality of slats, starting with a lowermost slat; and
 tilting means which is disposed on a rear side of said slat and tilts said plurality of slats on the basis of the raising and lowering of said slats by said raising and lowering mechanism, wherein said raising and lowering mechanism includes a rotating body rotatably supported by said frame, a flexible elongated member wound around the rotating body so as to travel on one side in the vertical direction and to travel on another side in an opposite direction, and a coupling mechanism for coupling one side of the elongated member to said lowermost slat to allow the traveling of the elongated member on one side to be transmitted to said plurality of slats, and wherein said tilting means includes: a slat supporting mechanism including a slat supporting member for supporting a supported portion of an uppermost slat of said plurality of slats rotatably and movably in a front-back direction and mounting means for mounting the slat supporting member to said frame; and a linearly moving mechanism including a linearly movable member which rotatably supports a rear edge portion of said uppermost slat located rearwardly of the supported portion, is linearly movable in the vertical direction, and in the linear movement thereof in the vertical direction causes said slat to tilt by the relative displacement of the rear edge portion in the vertical direction relative to the supported portion, and transmitting means for transmitting the traveling of the flexible elongated member on the other side to the linearly movable member so as to linearly move the linearly movable member in the vertical direction on the basis of the raising and lowering of said slats by said raising and lowering mechanism, the trans-

mitting means having an abutment member which is mounted on another side of the elongated member and which, in order to transmit the traveling on the other side of the elongated member in the vertical direction to the linearly movable member, abuts against the linearly movable member in that traveling.

2. The window blind apparatus according to claim 1, wherein the supported portion of said uppermost slat which is supported by the slat supporting member is located forwardly of a center of gravity of said slat.
3. The window blind apparatus according to claim 1 or 2, further comprising urging means for urging said uppermost slat in a tilting direction when the opening is opened.
4. The window blind apparatus according to claim 3, wherein said urging means includes a resiliently urging member for urging the linearly movable member in the vertical direction.
5. The window blind apparatus according to any one of claims 1 to 4, wherein the slat supporting member includes an elongated hole or a slit which extends in the front-back direction and in which the supported portion of said uppermost slat is disposed movably in the front-back direction.
6. The window blind apparatus according to claim 5, wherein the elongated hole of the slat supporting member or the slit is inclined forwardly downwardly.
7. The window blind apparatus according to any one of claims 1 to 6, wherein the slat supporting member is mounted on said frame linearly movably in the vertical direction, and said frame is provided with a stopper for stopping the lowering of the slat supporting member by more than a predetermined amount by abutting against the slat supporting member.
8. The window blind apparatus according to any one of claims 1 to 7, wherein the linearly movable member is connected to the slat supporting member so as to undergo relative displacement by a predetermined amount in the vertical direction relative to the slat supporting member.
9. The window blind apparatus according to claim 8, wherein the linearly movable member has an elongated hole or a slit extending in the vertical direction, and the slat supporting member has a shaft which is disposed in the elongated hole or the slit vertically movably.
10. The window blind apparatus according to claim 9, wherein at least two shafts are provided in the slat

supporting member as the shaft, and these at least two shafts are opposed to each other in the vertical direction.

11. The window blind apparatus according to any one of claims 1 to 10, wherein an end portion on the one side of the elongated member is connected to said lowermost slat through the coupling mechanism, and the abutment member is mounted on the end portion on the other side of the elongated member.
12. The window blind apparatus according to any one of claims 1 to 11, wherein the end portion on the one side of the elongated member is located on a forward side in the front-back direction relative to the end portion on the other side of the elongated member.
13. The window blind apparatus according to any one of claims 1 to 12, wherein the rotating body is constituted by a sprocket wheel, and the elongated member is constituted by a chain wound around the sprocket wheel.
14. The window blind apparatus according to any one of claims 1 to 13, wherein said link mechanism includes a first link member for connecting said plurality of slats to each other and a second link member disposed rearwardly of the first link member and connecting said plurality of slats to each other, at least one of the first and the second link members having one continuous flexible cord-like member which is rotatably connected at the upper end thereof to a longitudinal end portion of said uppermost slat and is rotatably connected at the lower end thereof to a longitudinal end portion of said lowermost slat, and a plurality of rotational connectors which are secured to the cord-like member and are respectively rotatably connected to longitudinal end portions of said plurality of slats excluding said uppermost slat and said lowermost slat, an upper end of the rotational connector at the time of opening of the opening being rotatably connected to a lower end of another rotational connector upwardly adjacent to that rotational connector, a lower end of the rotational connector at the time of opening of the opening being rotatably connected to an upper end of another rotational connector downwardly adjacent to that rotational connector.
15. The window blind apparatus according to any one of claims 1 to 13, wherein said link mechanism includes a first link member for connecting said plurality of slats to each other and a second link member disposed rearwardly of the first link member and connecting said plurality of slats to each other, at least one of the first and the second link members having a plurality of rotational connectors which are respectively rotatably connected to longitudinal end por-

- tions of said plurality of slats excluding said uppermost slat and said lowermost slat, and flexible cord-like members which connect an upper end of the rotational connector to a lower end of another rotational connector upwardly adjacent to that rotational connector at the time of opening of the opening, and connect a lower end of the rotational connector to an upper end of another rotational connector downwardly adjacent to that rotational connector at the time of opening of the opening, wherein the cord-like member, which is secured at an one end thereof to the upper end, at the time of opening of the opening, of the rotational connector connected to said slat adjacent to said uppermost slat in the vertical direction, is rotatably connected at another end thereof to said uppermost slat, while the cord-like member, which is secured at the other end thereof to the lower end, at the time of opening of the opening, of the rotational connector connected to said slat adjacent to said lowermost slat in the vertical direction, is rotatably connected at the one end thereof to said lowermost slat.
16. The window blind apparatus according to claim 15, wherein a hole or a recess into which an end portion of the cord-like member is inserted and a retaining pawl for retaining the end portion of the cord-like member to prevent the end portion of the cord-like member inserted in the hole or the recess from coming off are formed in each of both ends of the plurality of rotational connectors.
17. The window blind apparatus according to claim 16, wherein an enlarged portion is formed at the end portion of the cord-like member.
18. The window blind apparatus according to any one of claims 14 to 17, wherein each of the plurality of rotational connectors has at an intermediate portion between the upper end and the lower end thereof a connecting portion which is rotatably connected to a corresponding one of said slats.
19. The window blind apparatus according to any one of claims 14 to 18, wherein the connecting portion of each of the plurality of rotational connectors is detachably connected to the longitudinal end portion of a corresponding one of said slats in a snap-fitting manner.
20. The window blind apparatus according to any one of claims 14 to 19, wherein the cord-like member is constituted by a woven fabric or a braid of a synthetic resin yarn or a wire rope.
21. The window blind apparatus according to any one of claims 14 to 20, wherein the plurality of rotational connectors are respectively arranged at equal intervals therebetween at the time of opening of the opening.
22. The window blind apparatus according to any one of claims 1 to 21, wherein said frame has a pair of vertical frames which oppose each other in a lateral direction, at least one of the pair of vertical frames has an outer frame and an inner frame which is covered by the outer frame and is detachably mounted on the outer frame, and the inner frame has guide grooves for guiding the elongated member and the mounting means of the slat supporting member in the vertical direction.
23. The window blind apparatus according to any one of claims 1 to 22, wherein the coupling mechanism includes a coupling main body coupled to the elongated member, a coupling arm which is rotatably coupled at an one end thereof to said lowermost slat and is rotatably coupled at another end thereof to the coupling main body, and a seat plate which is mounted on the coupling main body in such manner as to extend in the lateral direction and on which said lowermost slat is seated, and wherein the seat plate has a seat plate portion which extends in the lateral direction and on which said lowermost slat is seated when the opening is opened and a cover plate portion which is connected to a rear edge of the seat plate portion in such a manner as to extend in the vertical direction and covers an underside part underneath said lowermost slat when the opening is closed.
24. The window blind apparatus according to claim 23, wherein one end of the coupling arm is rotatably coupled to said lowermost slat forwardly of a center of gravity of said slat.
25. The window blind apparatus according to claim 23 or 24, wherein the coupling mechanism further includes a hampering piece which is integrally formed with the other end of the coupling arm and is brought into contact with the coupling main body so as to hamper the rotation of the coupling arm by more than a predetermined amount which occurs when the coupling main body is raised with respect to said lowermost slat by the traveling of the elongated member.
26. The window blind apparatus according to any one of claims 23 to 25, wherein the coupling mechanism further includes a coupling member for coupling the coupling main body to the elongated member and a resilient member interposed between the coupling main body and the coupling member in the vertical direction, and wherein one of the coupling main body and the coupling member has an elongated hole extending in the vertical direction, while the other one of the coupling main body and the coupling member has a shaft disposed in the elongated hole movably

in the vertical direction, such that when the traveling of the elongated member by a fixed distance or more has occurred, the coupling member is caused to undergo movement in the vertical direction relative to the coupling main body against the resiliency of the resilient member. 5

27. The window blind apparatus according to claim 26, wherein the coupling member is mounted on said frame vertically movably. 10

15

20

25

30

35

40

45

50

55

FIG. 1

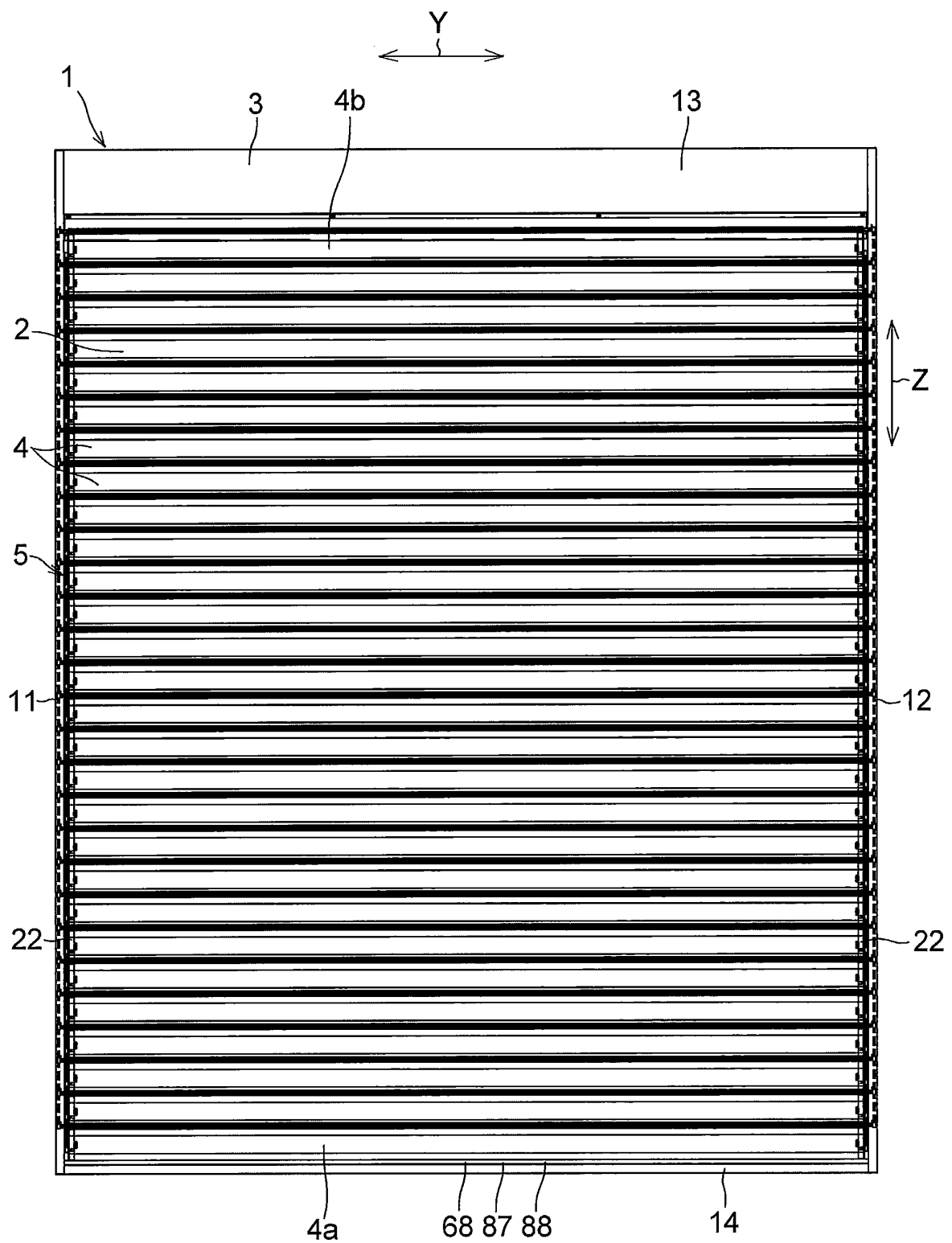


FIG. 2

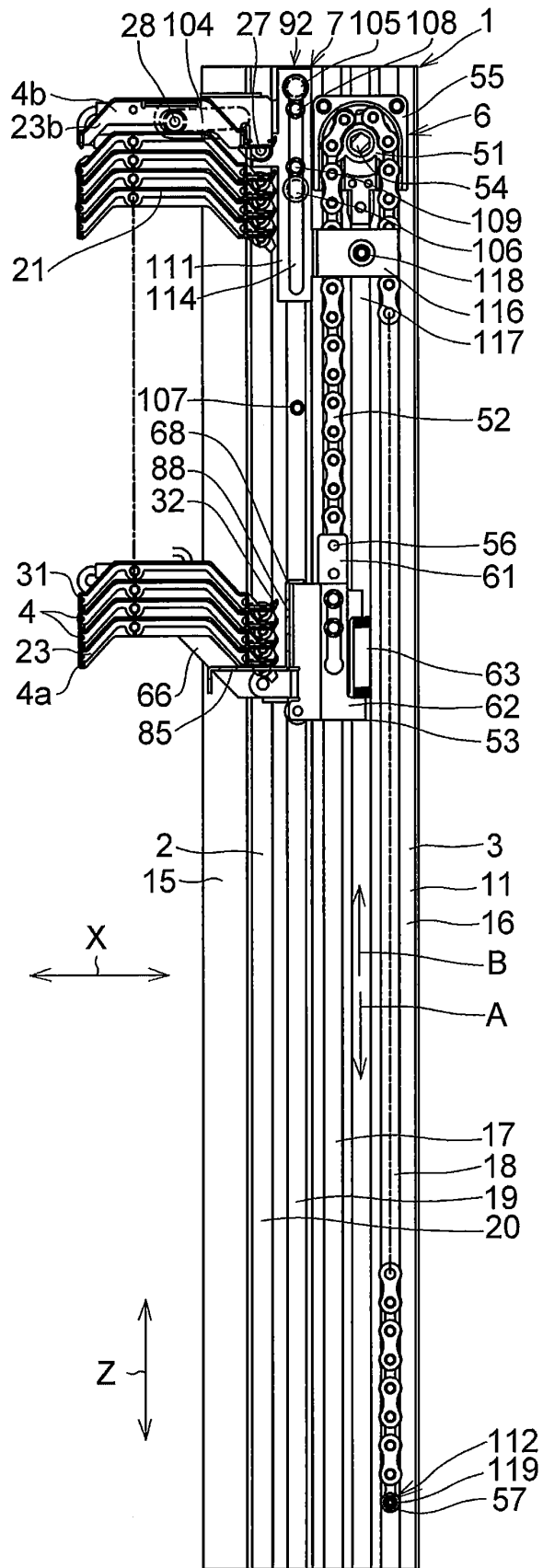


FIG. 3

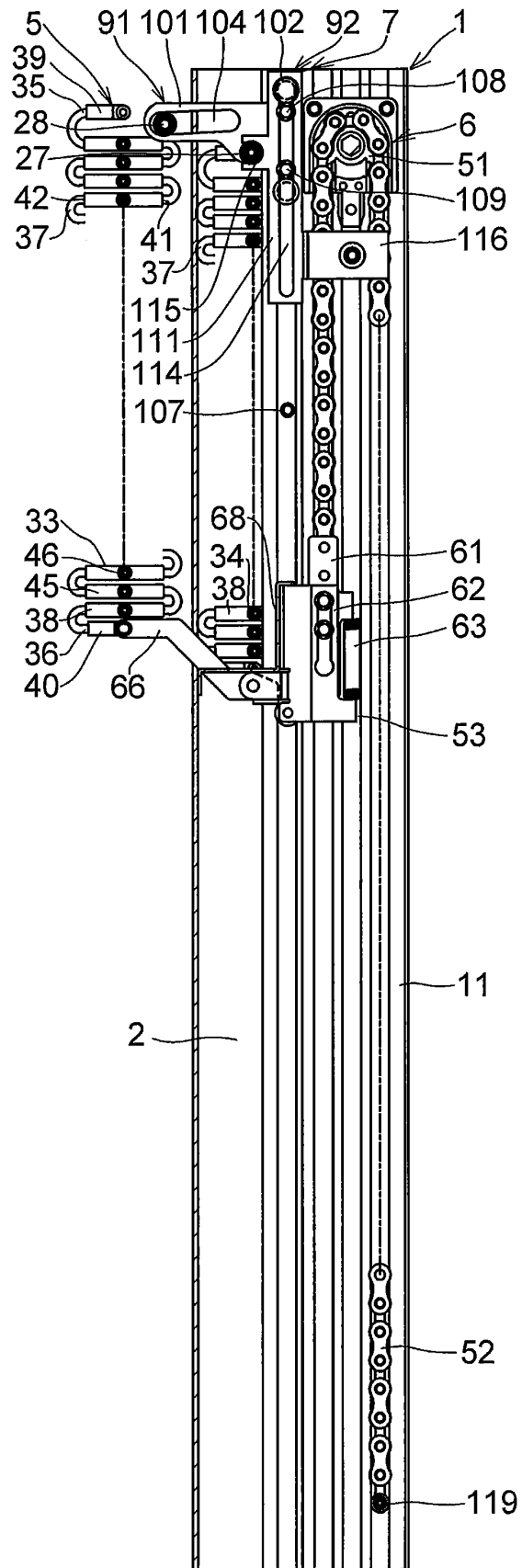


FIG. 4

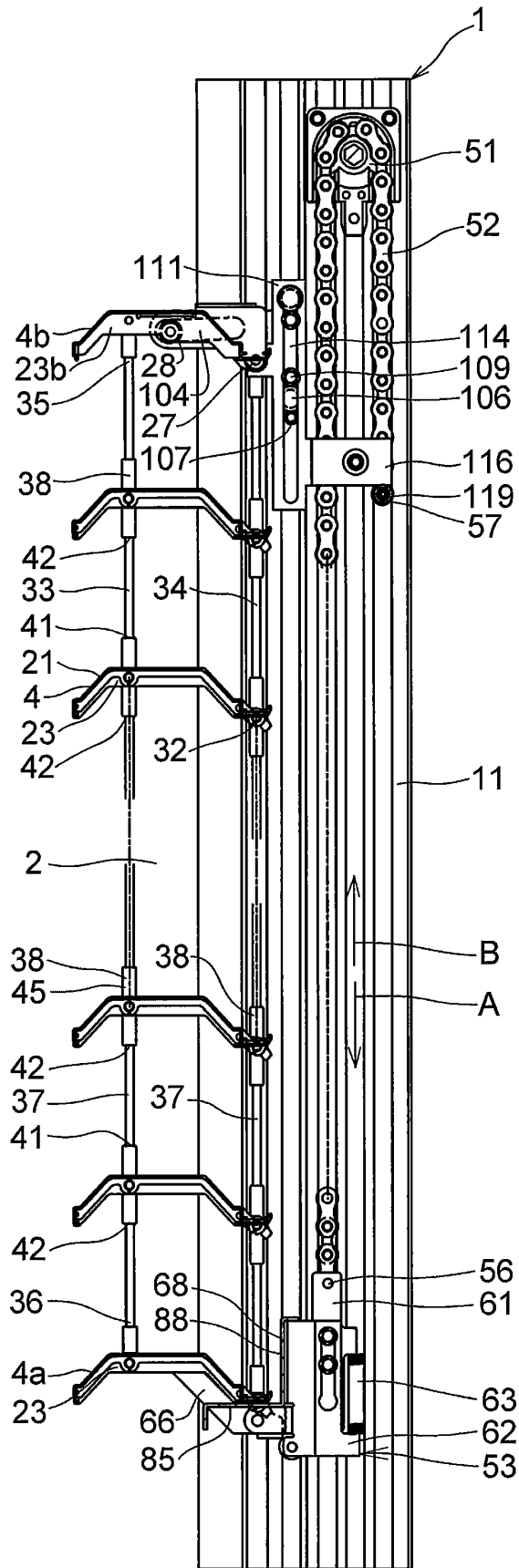


FIG. 5

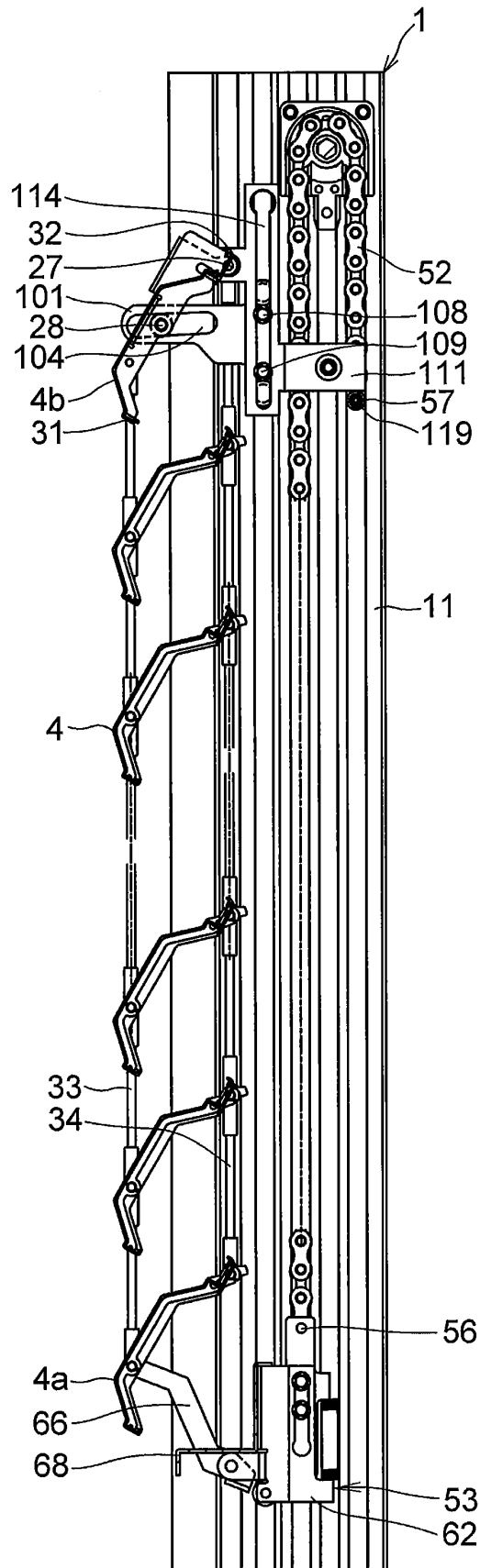


FIG. 6

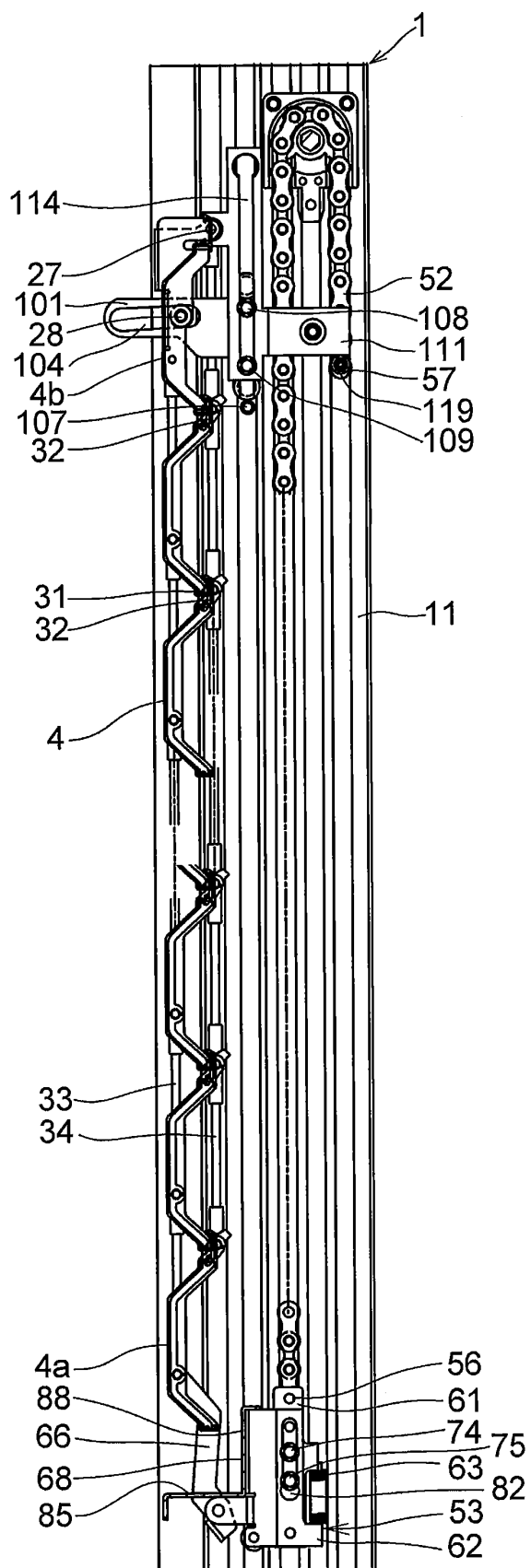
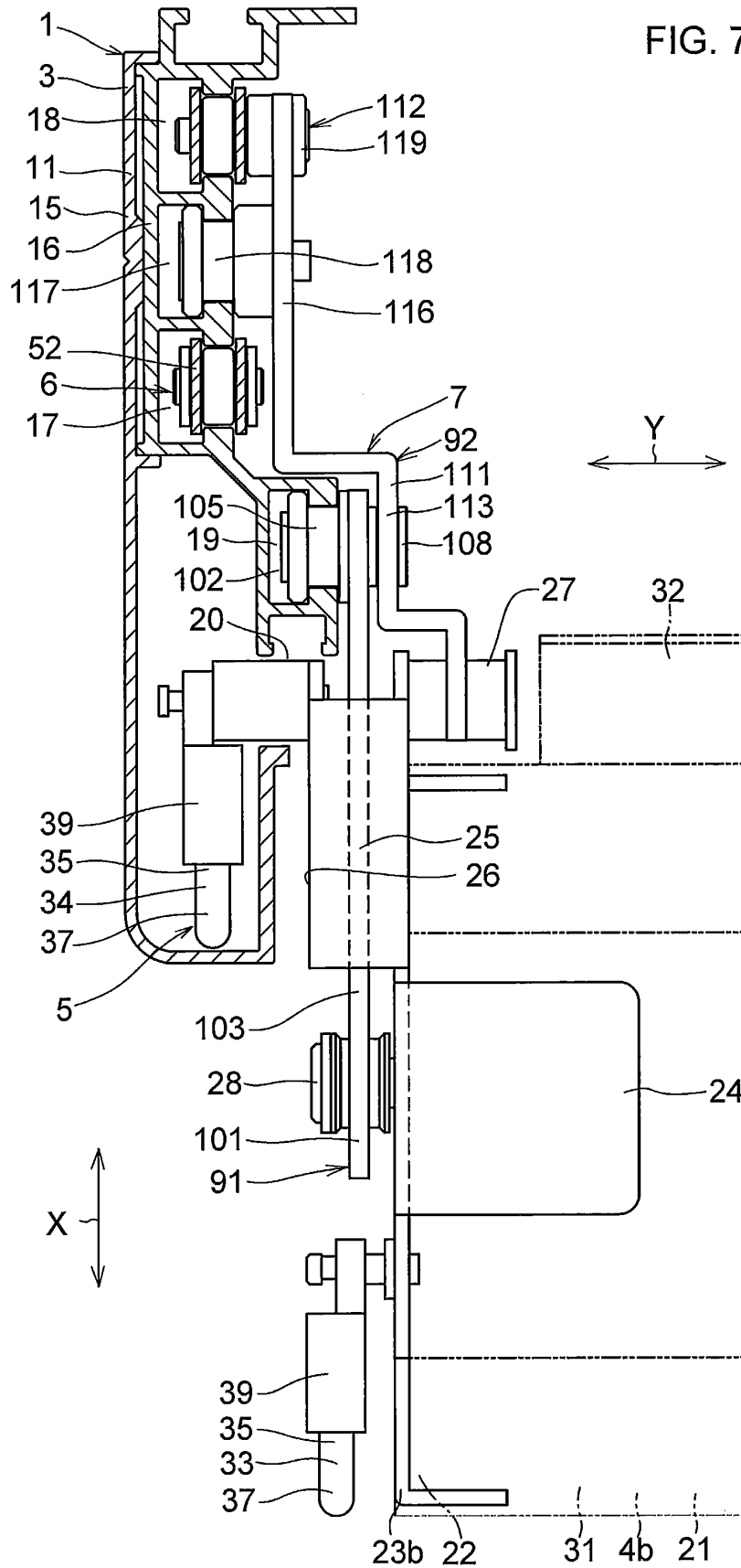


FIG. 7



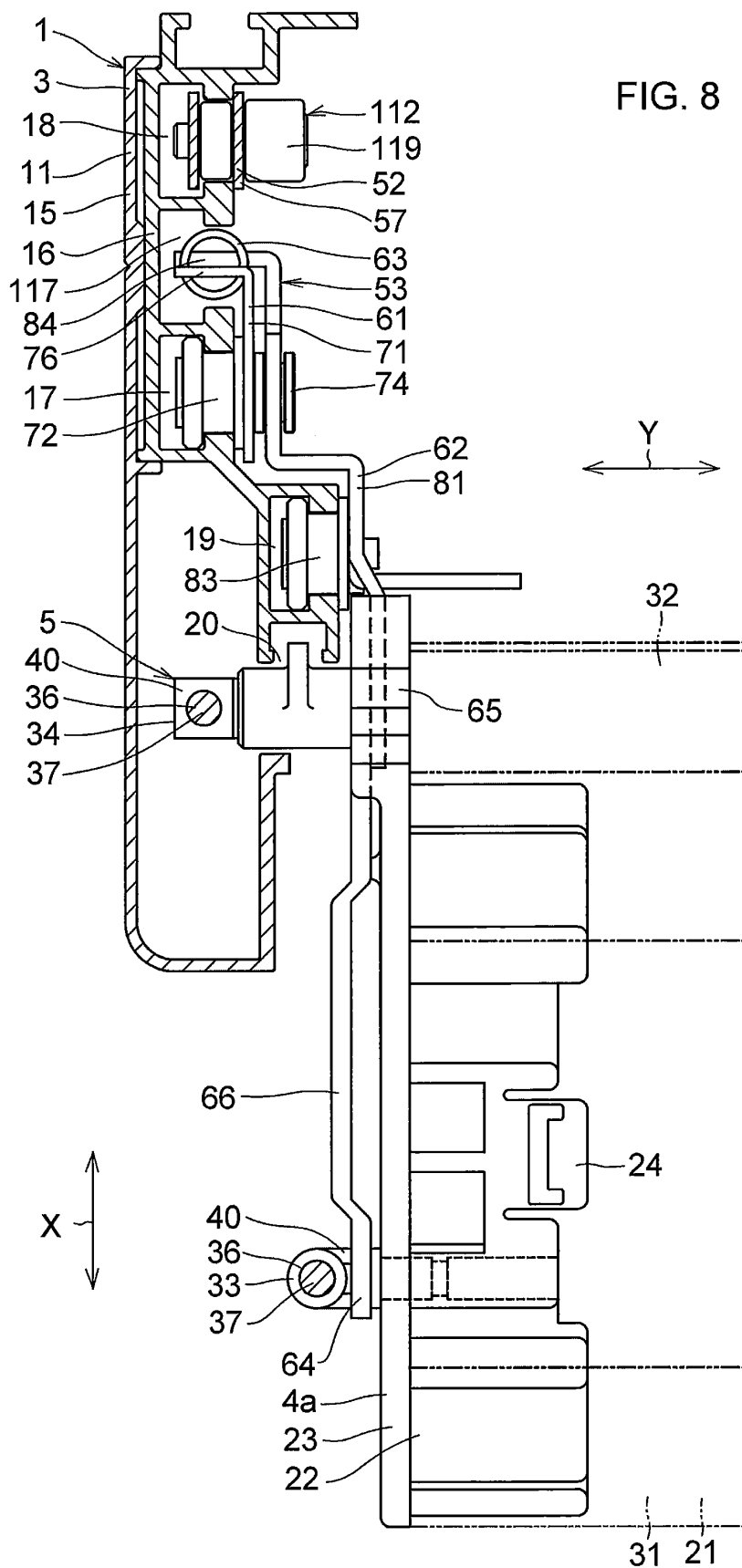


FIG. 9

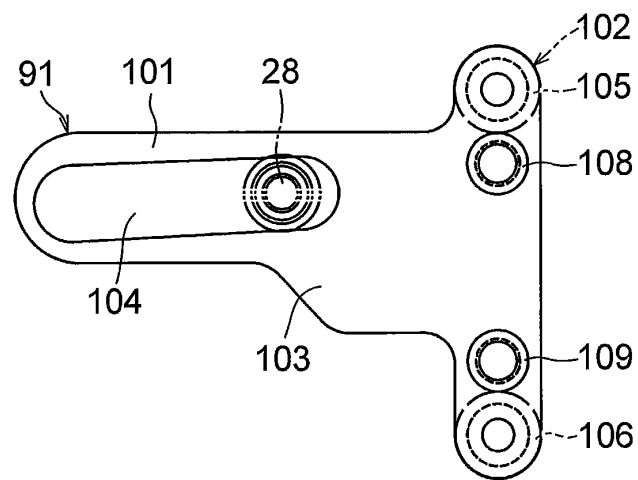


FIG. 10

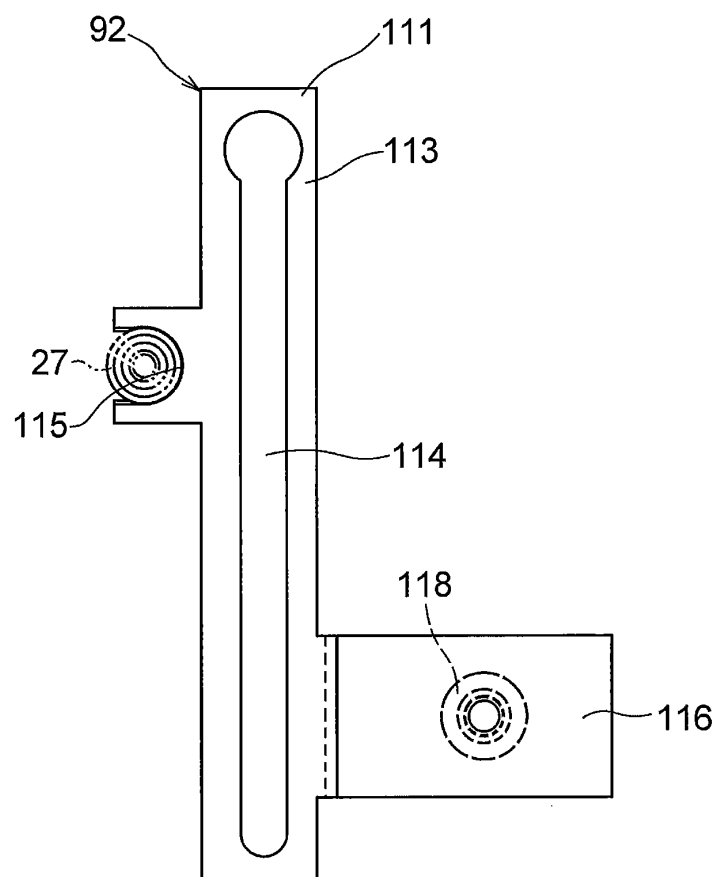


FIG. 11

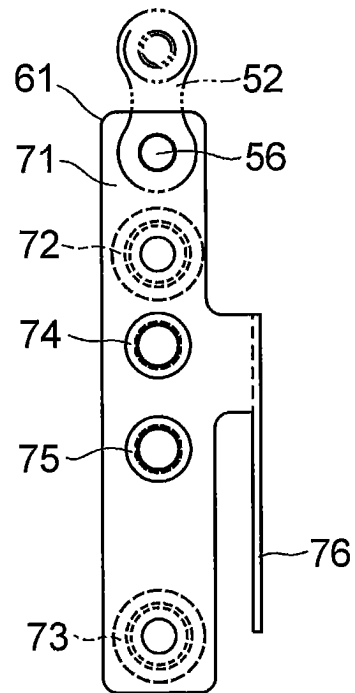


FIG. 12

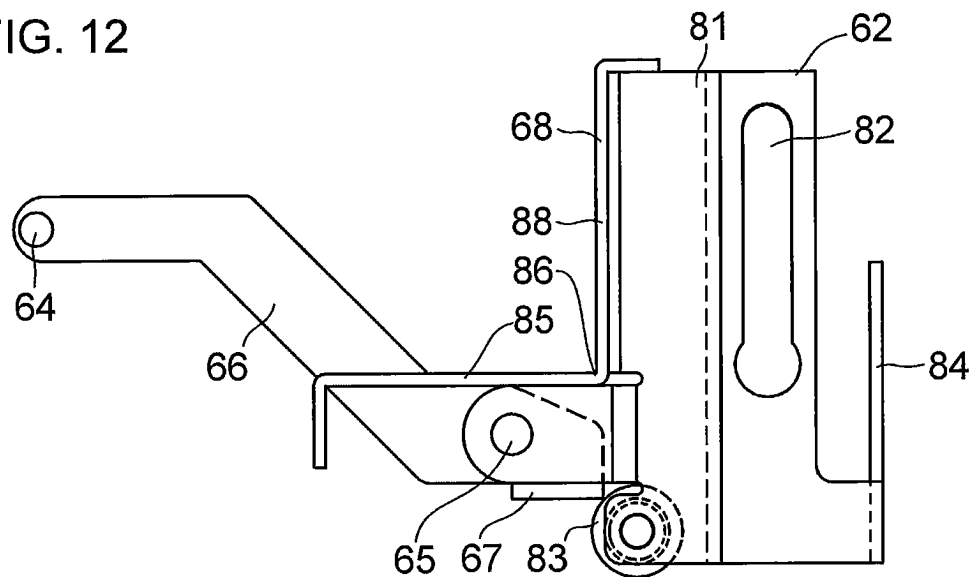
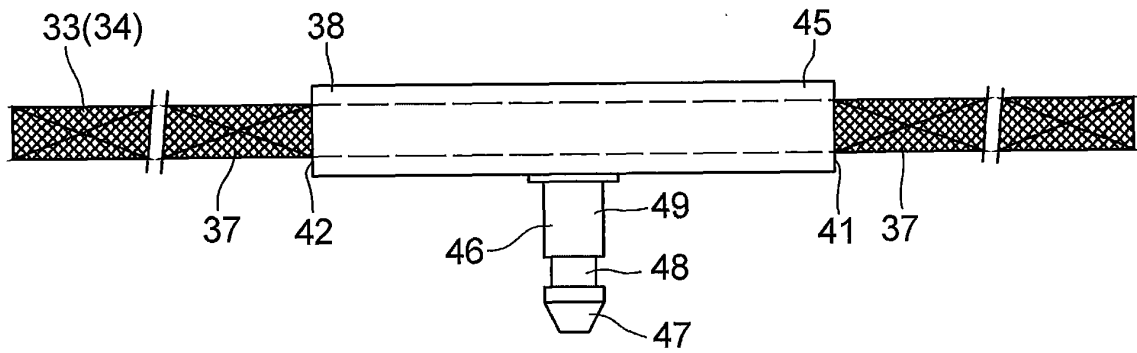
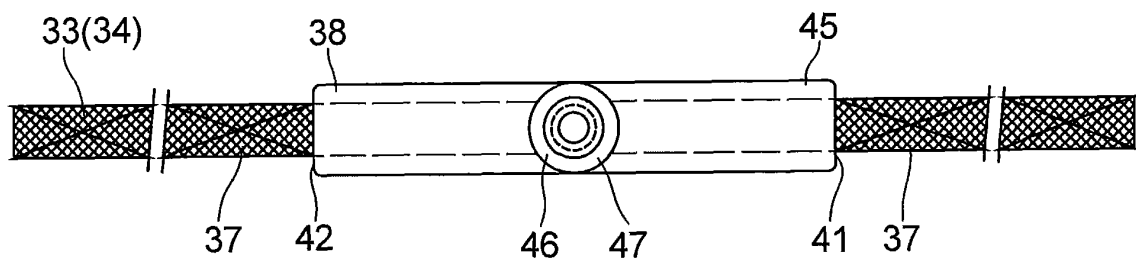


FIG. 13

(a)



(b)



(c)

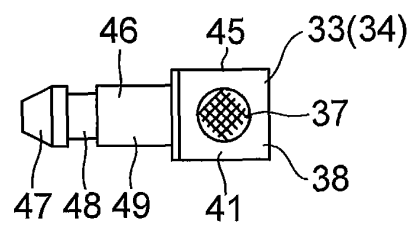


FIG. 14

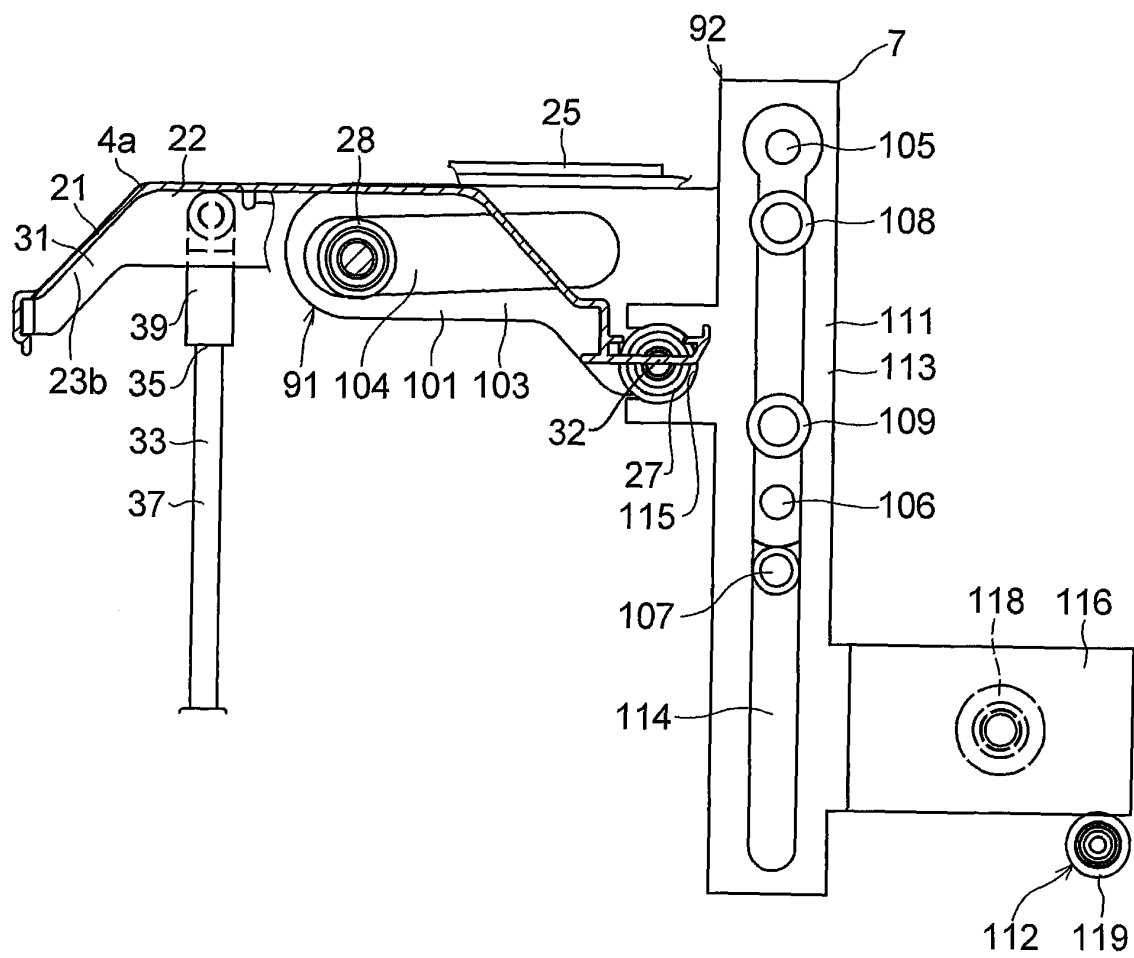


FIG. 15

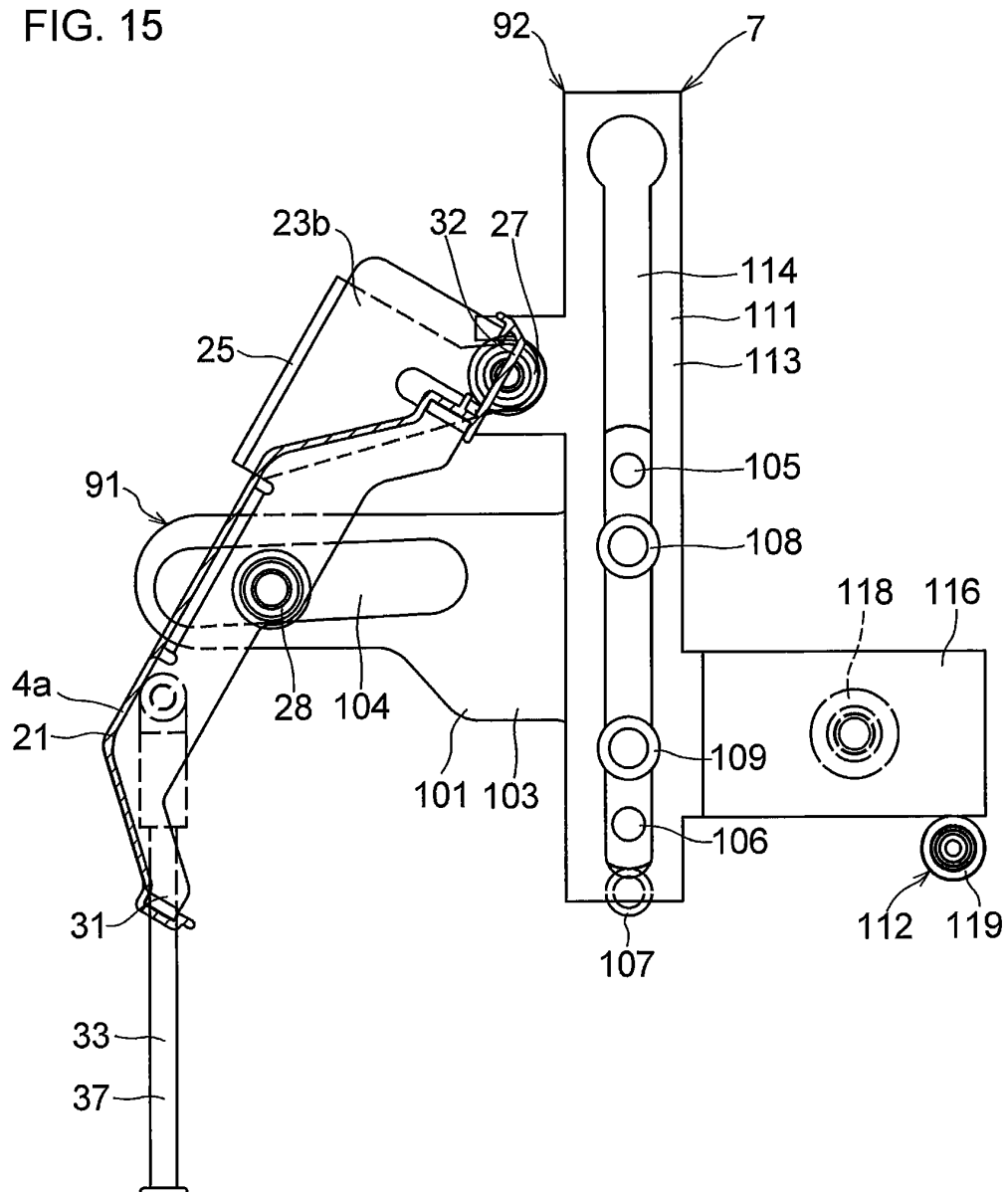


FIG. 16

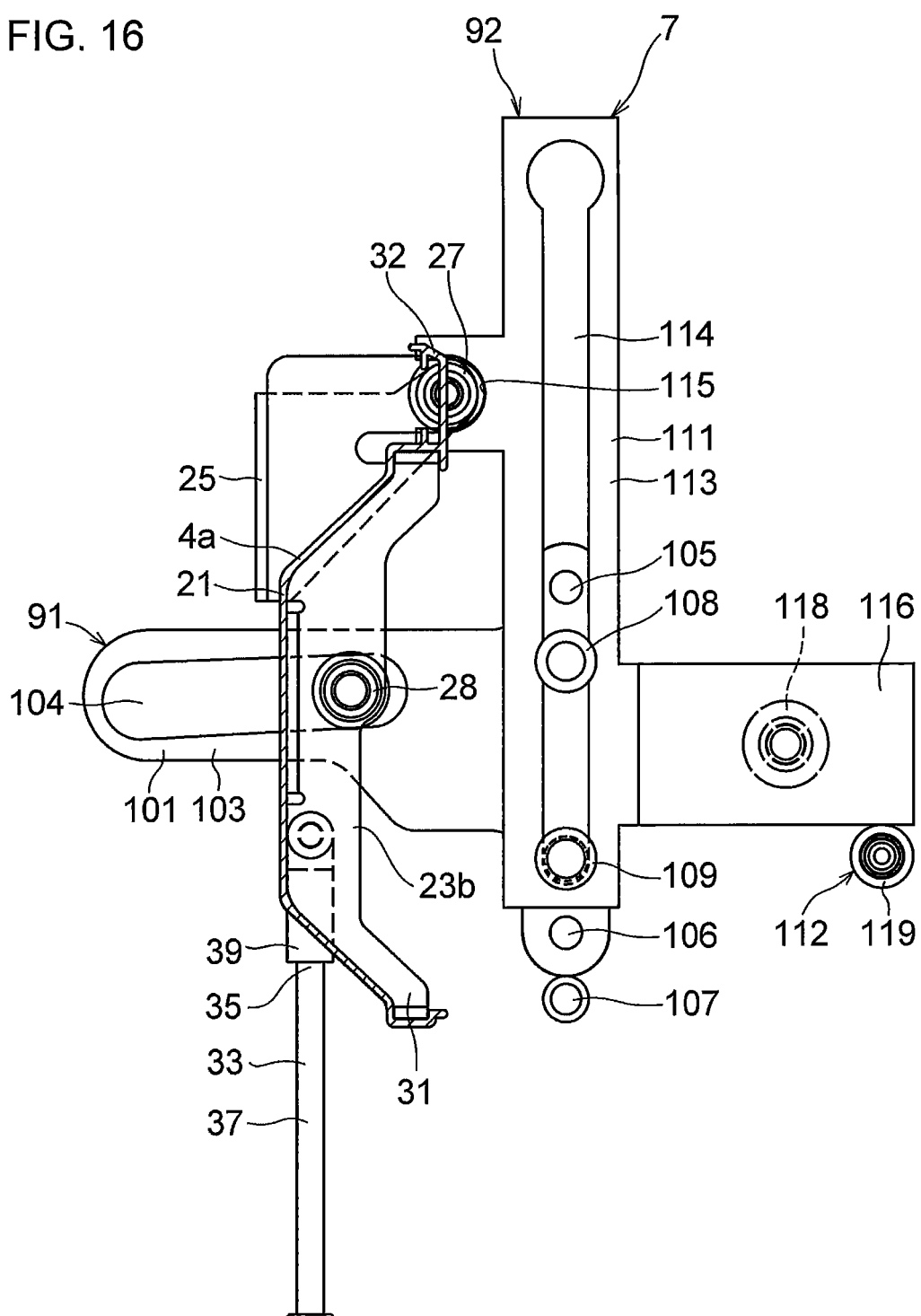


FIG. 17

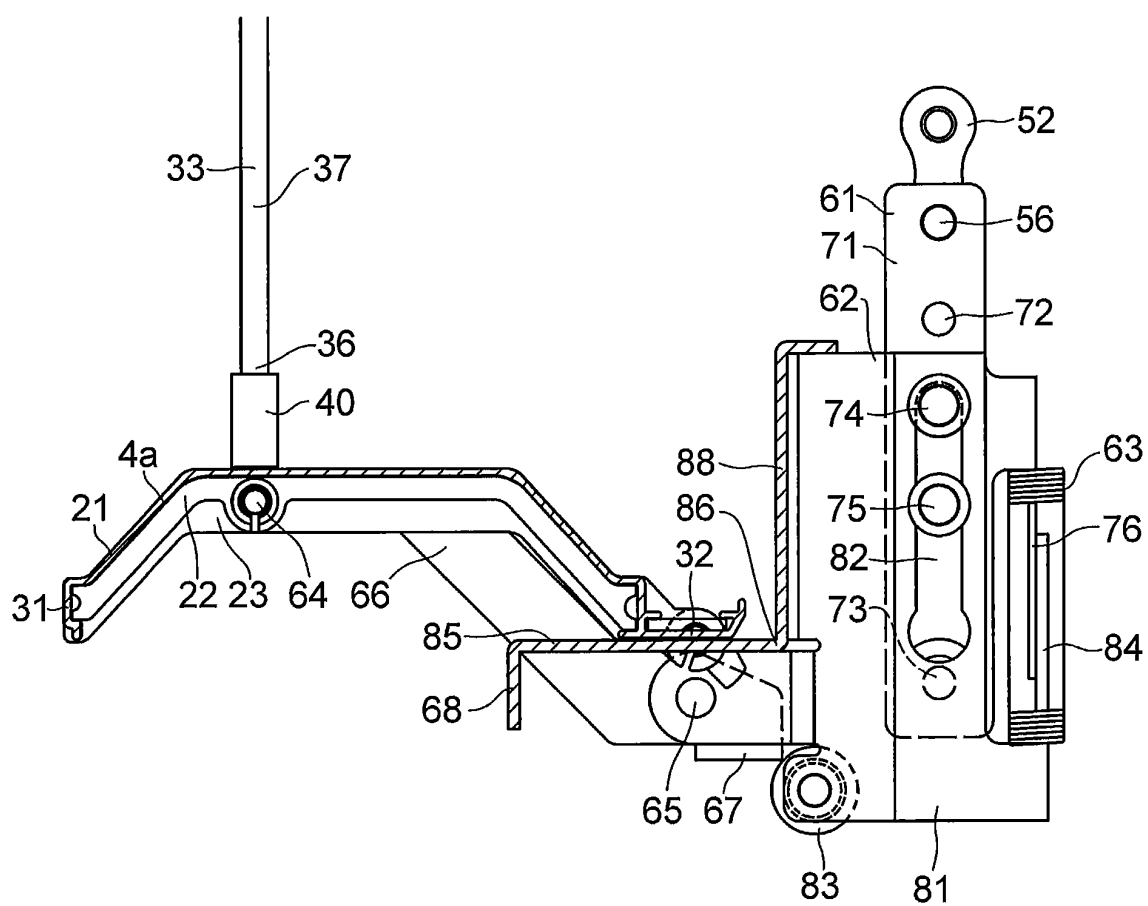


FIG. 18

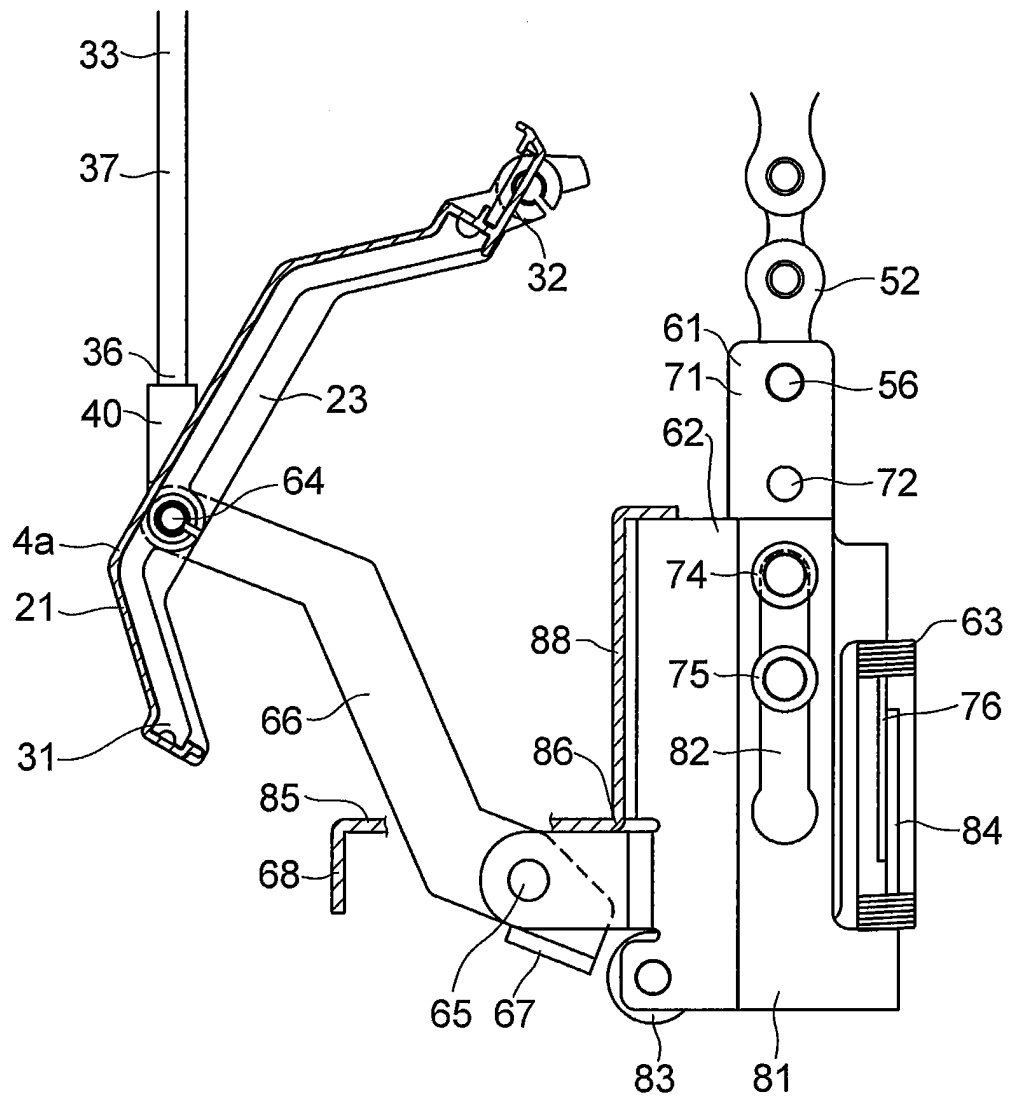


FIG. 19

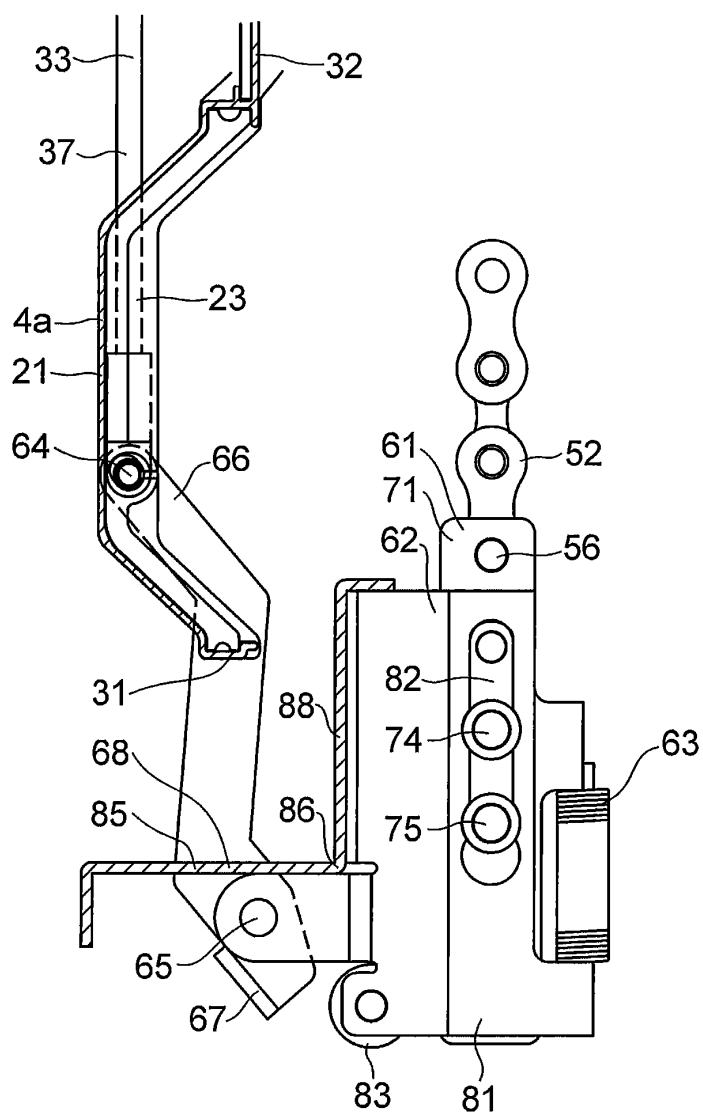
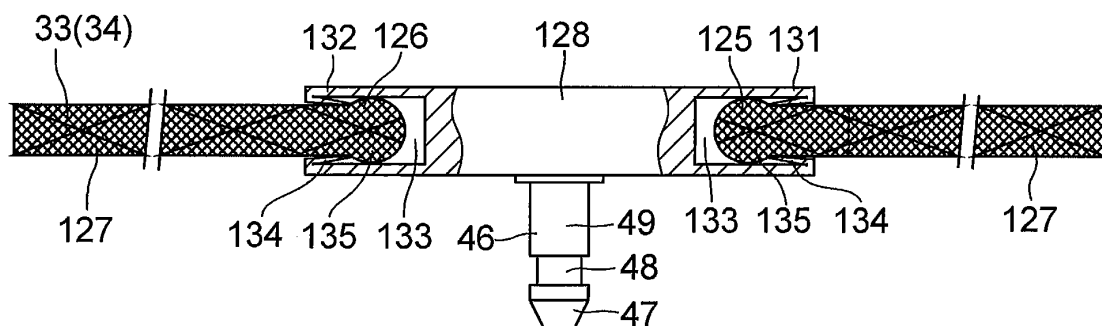


FIG. 20



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/000768

A. CLASSIFICATION OF SUBJECT MATTER

E06B9/322 (2006.01) i, E06B9/02 (2006.01) i, E06B9/302 (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)

E06B9/322, E06B9/02, E06B9/302

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	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

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.
A	JP 4604670 B2 (Oiles Eco Corp.), 05 January 2011 (05.01.2011), paragraph [0052]; fig. 13 to 16 (Family: none)	1-27
A	WO 2009/022370 A1 (Oiles Eco Corp.), 19 February 2009 (19.02.2009), paragraphs [0071] to [0075]; fig. 3, 17 to 19 & WO 2009/022370 A1 & CN 101802339 A	1-27

☐ 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

"I" 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
13 May, 2013 (13.05.13)Date of mailing of the international search report
21 May, 2013 (21.05.13)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (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 2004156289 A [0004]
- JP 2007239309 A [0004]