



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

(43) Date of publication:
24.01.2018 Bulletin 2018/04

(51) Int Cl.:
E05D 3/12 (2006.01)

(21) Application number: **16764703.1**

(86) International application number:
PCT/JP2016/056524

(22) Date of filing: **03.03.2016**

(87) International publication number:
WO 2016/147873 (22.09.2016 Gazette 2016/38)

(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
Designated Validation States:
MA MD

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(30) Priority: **16.03.2015 JP 2015052172**

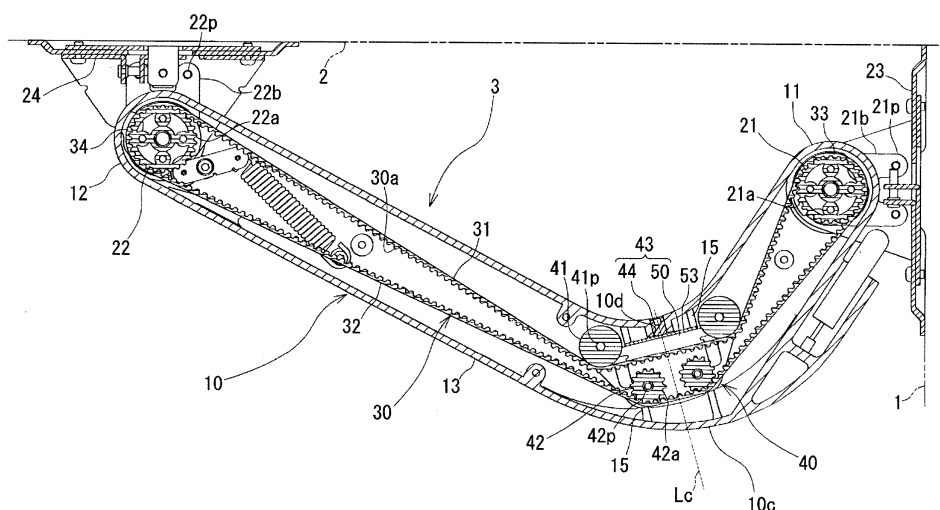
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(54) **HINGE DEVICE**

(57) It is an object to prevent an angle of a second member such as a door from being changed when tension is applied to an endless connecting body in a hinge device. An endless connecting body 30 is wound around between a first rotating body 21 in a first end portion 11 of an arm 10 of a hinge device 3 and a second rotating body 22 in a second end portion 12 of the arm 10 of the hinge device 3 to connect the rotating bodies 21, 22 with

each other so that the rotating bodies 21, 22 can be rotated with respect to the arm 10 in the same direction. Positions of a first intermediate body 41 and a second intermediate body 42 are adjusted by adjusting means 43 of tension applying means 40 to tense a first bridging portion 31 and a second bridging portion 32 of the endless connecting body 30, thereby applying the tension to the endless connecting body 30.

FIG. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to, for example, a hinge device for coupling a second member such as a door with a first member such as a housing so that the second member can be relatively moved with respect to the first member, in particular to a hinge device suitable for rotating the second member such as a door with respect to the first member in a state that the second member is directed toward a fixed direction.

BACKGROUND ART

[0002] This type of hinge device includes an arm, a pair of pulleys and a belt which are contained in this arm (see patent document 1). One of the pulleys (a first rotating body) is rotatably provided in one end portion of the arm and fixed to a first member such as a housing. The other one of the pulleys (a second rotating body) is rotatably provided in the other end portion of the arm and fixed to a door (a second member). The belt (an endless connecting body) is wound around between the two pulleys. With this connection due to the belt, both of the two pulleys are rotated in the same direction with respect to the arm when the door is being opened or closed. Thus, the door is opened and closed in a state that the door is always directed to a fixed direction.

[0003] In a hinge device disclosed in patent document 2, an arm is curved into a dogleg shape. Two rollers (intermediate bodies) are provided in this curved portion. Due to these rollers, a belt is curved along the arm. One of the rollers can be slid in a horizontal direction, thereby applying tension to the belt.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0004]

Patent document 1: JP 2006-526719A (Fig. 1)

Patent document 2: US 5289615B (lines 5 to 7, column 11 and Fig. 7)

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005] A belt for this type of hinge device is constituted of hard rubber or the like and hardly expands and contracts. In this regard, in order to connect and rotate two pulleys, it is required that a certain level of tension should be applied to the belt. Thus, it is necessary to wind the belt around between the two pulleys with pulling the belt for applying the tension to the belt. For this reason, an attaching operation for the belt is not easy.

[0006] Further, in the hinge device of the above patent document 2, the tension is applied to only a one-sided half circumferential portion (a bridging portion) of the belt by pushing the belt with one roller. In this case, there is risk that imbalance of tension occurs between the one-sided half circumferential portion and the other one-sided half circumferential portion (another bridging portion) of the belt and an angle of the door is changed.

[0007] The present invention is achieved with considering the above circumstances and intended to allow an endless connecting body such as a belt in a hinge device to be easily attached to an arm and prevent imbalance of tension from occurring between two bridging portions of the endless connecting body, thereby preventing or suppressing an angle of a second member such as a door from being changed.

MEANS OF SOLVING THE PROBLEMS

[0008] In order to solve the above problem, the present invention provides a hinge device for coupling a second member with a first member so that the second member can be relatively moved with respect to the first member, the hinge device comprising:

an arm;

a first rotating body rotatably provided in a first end portion of the arm in a lengthwise direction of the arm and fixed to the first member;

a second rotating body rotatably provided in a second end portion opposite to the first end portion of the arm and fixed to the second member;

an endless connecting body for connecting the first and second rotating bodies with each other so that the first and second rotating bodies can be rotated with respect to the arm in the same direction, the endless connecting body having two wound portions respectively wound around the first and second rotating bodies and first and second bridging portions each bridged between the first and second rotating bodies and being formed into an endless shape; and tension applying means for applying tension to the endless connecting body,

wherein the tension applying means includes:

a first intermediate body which makes contact with the first bridging portion and can be slid with respect to the arm in a direction for tensing or loosening the first bridging portion,

a second intermediate body which makes contact with the second bridging portion and can be slid with respect to the arm in a direction for tensing or loosening the second bridging portion, and adjusting means for adjusting positions of the first and second intermediate bodies in a slide direction of each of the first and second intermediate bodies.

[0009] According the hinge device having this distinct configuration, it is possible to easily attach the endless connecting body to the arm by winding the endless connecting body around between the first and second rotating bodies in a state that the endless connecting body is loosened. After that, tension is applied to the endless connecting body with the tension applying means. More specifically, the position of the first intermediate body is adjusted in its slide direction with the adjusting means. With this configuration, it is possible to tense the first bridging portion of the endless connecting body. In addition, the position of the second intermediate body is adjusted in its slide direction with the adjusting means. With this configuration, it is possible to tense the second bridging portion of the endless connecting body and balance tension working to each of the first and second bridging portions. As a result, it is possible to prevent or suppress an angle of the second member with respect to the first member from being changed.

[0010] It is preferred that the adjusting means includes:

one adjusting member to which actuating force for the positional adjustment is inputted, and transmission means for simultaneously transmitting the actuating force to the first and second intermediate bodies.

[0011] With this configuration, it is possible to simultaneously adjust the positions of the first intermediate body and the second intermediate body by operating the one adjusting member.

[0012] It is preferred that the first intermediate body makes contact with an outer circumferential surface of the first bridging portion, the second intermediate body makes contact with an inner circumferential surface of the second bridging portion, the transmission means includes a holding member for holding the first intermediate body and the second intermediate body and the holding member is slidably provided in the arm, and a position of the holding member is adjusted by the adjusting member.

[0013] By adjusting the position of the holding member with the adjusting member, it is possible to integrally adjust the positions of the first and second intermediate bodies. This makes it possible to reliably balance the tension working to each of the first and second bridging portions.

EFFECT OF THE INVENTION

[0014] According to the present invention, it is possible to easily attach the endless connecting body in the hinge device to the arm. Further, when the tension is applied to the endless connecting body, it is possible to prevent or suppress the angle of the second member with respect to the first member from being changed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

[Fig. 1] Fig. 1(a) is a planar view showing a hinge device according to a first embodiment of the present invention in a state that a door is closed. Fig. 1(b) is a back view showing the hinge device in Fig. 1(a) seen from a rear side of a housing.

[Fig. 2] Fig. 2 is a planar cross-sectional view of the hinge device taken along a II-II line in Fig. 1(b).

[Fig. 3] Fig. 3 is an exploded perspective view of the hinge device.

[Fig. 4] Fig. 4 is a planar cross-sectional view showing movement of the hinge device. Fig. 4(a) shows a closed position thereof, Fig. 4(b) shows a half-opened position thereof and Fig. 4(c) shows a full-opened position thereof.

[Fig. 5] Fig. 5 is a cross-sectional view of a curved portion of the hinge device taken along a V-V line in Fig. 4(b).

[Fig. 6] Fig. 6(a) is a planar view showing a holding member of the hinge device in a state that first and second intermediate bodies are attached to the holding member. Fig. 6(b) is a cross-sectional view taken along a VIb-VIb line in Fig. 6(a).

[Fig. 7] Fig. 7(a) is a planar cross-sectional view showing the curved portion of the hinge device in a state before tension is applied to an endless connecting body. Fig. 7(b) is a planar cross-sectional view showing the curved portion of the hinge device in a state that the tension is applied to the endless connecting body.

[Fig. 8] Fig. 8 is a perspective view showing a container device including the hinge device. Fig. 8(a) shows a state that a door is closed, Fig. 8(b) shows a state that the door is half-opened and Fig. 8(c) shows a state that the door is full-opened.

[Fig. 9] Fig. 9 is a planar cross-sectional view of a curved portion of a hinge device according to a second embodiment of the present invention. Fig. 9(a) shows a state before tension is applied to an endless connecting body. Fig. 9(b) shows a state that the tension is applied to the endless connecting body.

MODE FOR CARRYING OUT THE INVENTION

[0016] Hereinafter, embodiments of the present invention will be described with reference to the accompanying drawings.

[0017] Each of Figs. 1 to 8 shows a first embodiment of the present invention. As shown in Fig. 8, a container device M includes a housing 1 (a first member), a door 2 (a second member) and hinge devices 3. The door 2 is rotatably coupled with the housing 1 through the hinge devices 3. The plurality of hinge devices 3 (in the drawing, the number of the hinge devices 3 is two) are arranged so as to be separated from each other in an up-and-down

direction. These hinge devices 3 are coupled with each other through a vertical coupling rod 8. With the hinge devices 3, the door 2 is relatively moved with respect to the housing 1 between a full-closed position (Fig. 8(a)) and a full-opened position (Fig. 8(c)) with keeping a posture that the door 2 is directed toward a front side (a fixed direction). As shown in Fig. 8(b), the door 2 is moved toward the front direction at a half-opened position in the middle of the full-closed position and the full-opened position.

[0018] As shown in Fig. 1, the hinge device 3 includes an arm 10 and attachment members 23, 24. The housing-side attachment member 23 is attached to the housing 1. The door-side attachment member 24 is attached to the door 2. The arm 10 is arranged between these attachment members 23, 24.

[0019] As shown in Fig. 1(a), since the arm 10 extends in the horizontal direction and a curved portion 10c is formed at a middle portion in a lengthwise direction thereof, the arm 10 is curved into a dogleg shape (an L-shape) in a planar view thereof. As shown in Fig. 1, a first end portion 11 in the lengthwise direction of the arm 10 is arranged on the side of the flat housing 1 and a second end portion 12 opposite to the first end portion 11 is arranged on the side of the door 2. A length from the curved portion 10c to the second end portion 12 is longer than a length from the curved portion 10c to the first end portion 11. As shown in Fig. 3, the arm 10 has a housing 13 and a cover 14. The housing 13 is formed into a container shape which has a dogleg shape in a planar view thereof and whose upper end portion is opened. The cover 14 is formed into a dogleg plate-like shape and closes an upper end opening of the housing 13.

[0020] As shown in Fig. 2, a first rotating body 21 is contained in the first end portion 11 of the arm 10 so that an axial line thereof is directed toward the vertical direction (a direction perpendicular to the plane of paper of Fig. 2). The first rotating body 21 is constituted of a pulley and can rotate with respect to the arm 10 around its vertical axis. A meshing portion 21a including alternately-continuing convex portions and concave portions is formed on an outer circumferential surface of the first rotating body 21.

[0021] As shown in Fig. 3, an attachment plate 21b having a V shape is fixed to a lower end portion of the first rotating body 21. The attachment plate 21b is fixed to the housing-side attachment member 23 with attachment pins 21P. With this configuration, the first end portion 11 of the arm 10 is rotatably coupled with the housing 1 through the first rotating body 21 and the housing-side attachment member 23.

[0022] As shown in Fig. 2, a second rotating body 22 is contained in the second end portion 12 of the arm 10 so that an axial line thereof is directed toward the vertical direction (the direction perpendicular to the plane of paper of Fig. 2). The second rotating body 22 is constituted of a pulley having the same size as that of the first rotating body 21 and can rotate with respect to the arm 10 around

its vertical axis. A meshing portion 22a including alternately-continuing convex portions and concave portions is formed on an outer circumferential surface of the second rotating body 22. A gear ratio of the first rotating body 21 and the second rotating body 22 (a ratio of the number of the convex or concave portions of the meshing member 21a and the number of the convex or concave portions of the meshing member 22a) is one.

[0023] As shown in Fig. 3, an attachment plate 22b having a V shape is fixed to a lower end portion of the second rotating body 22. The attachment plate 22b is fixed to the door-side attachment member 24 with attachment pins 22p. With this configuration, the second end portion 12 of the arm 10 is rotatably coupled with the door 2 through the second rotating body 22 and the door-side attachment member 24.

[0024] As shown in Fig. 2, an endless connecting body 30 is contained in the arm 10. The endless connecting body 30 is constituted of a timing belt made of hard rubber, for example. An outer circumferential surface of the endless connecting body 30 is smooth. A meshing portion 30a including alternately-continuing convex portions and concave portions is formed on an inner circumferential surface of the endless connecting body 30. This endless connecting body 30 is wound around between the first rotating body 21 and the second rotating body 22. Thus, the endless connecting body 30 has two bridging portions 31, 32 and two wound portions 33, 34. Since these members 31 to 34 are circularly connected with each other, the endless connecting body 30 is formed into an endless shape. The bridging portions 31, 32 are bridged between the rotating bodies 21, 22. The first bridging portion 31 is arranged on the inner circumferential side of the doglegged arm 10 (on the upper side in Fig. 2). The second bridging portion 32 is arranged on the outer circumferential side of the arm 10 (on the lower side in Fig. 2). The first wound portion 33 is wound around the first rotating body 21. The meshing portion 30a of the first wound portion 33 meshes with the meshing portion 21a of the first rotating body 21. The second wound portion 34 is wound around the second rotating body 22. The meshing portion 30a of the second wound portion 34 meshes with the meshing portion 22a of the second rotating body 22. The rotating bodies 21, 22 are connected with each other by the endless connecting body 30 so that the rotating bodies 21, 22 can be rotated with respect to the arm 10 in the same direction and with the same speed as each other. With this configuration, the door 2 can be opened and closed with keeping a posture that the door 2 is always directed toward the front side (the fixed direction, an upper side in Fig. 4) as shown in Fig. 4.

[0025] As shown in Fig. 2, tension applying means 40 is provided in the curved portion 10c of the arm 10. Tension is applied to the endless connecting body 30 by the tension applying means 40. The tension applying means 40 includes two (a plurality of) first intermediate bodies 41, 41, two (a plurality of) second intermediate bodies

42, 42 and adjusting means 43.

[0026] As shown in Fig. 3, the first intermediate body 41 is constituted of a roller having a cylindrical shape or a pulley. An outer circumferential surface of the first intermediate body 41 is smooth.

[0027] The second intermediate body 42 is formed into a cylindrical shape and a meshing portion 42a including alternately-continuing convex portions and concave portions is formed on an outer circumferential surface of the second intermediate body 42.

[0028] As shown in Fig. 2, the adjusting means 43 includes a screw member 44 (an adjusting member) and a holding member 50. The screw member 44 is constituted of a socket set screw and arranged in a side wall of the curved portion 10c of the arm 10 on the inner circumferential side thereof (on the upper side in Fig. 2). A screw hole 10d is formed in this side wall. The screw member 44 is screwed into the screw hole 10d. An axial line Lc of the screw member 44 and the screw hole 10d is along a line which divides a bend angle at the curved portion 10c of the arm 10 into two substantially equal angles and is directed toward the horizontal direction.

[0029] As shown in Fig. 3 and Fig. 6, the holding member 50 has holding plates 51, 52 and a back plate 53 which are integrated with each other. Each of the upper holding plate 51 and the lower holding plate 52 has a horizontal plate-like shape and the holding plates 51, 52 face with each other in the up-and-down direction. The back plate 53 has a vertical plate-like shape. Side edges of the holding plates 51, 52 on the inner circumferential side thereof (on the upper side in Fig. 6) are coupled with each other by the back plate 53.

[0030] As shown in Fig. 7, the holding member 50 is contained in the curved portion 10c of the arm 10. The holding member 50 can be slid with respect to the arm 10 along the axial line Lc.

[0031] Specifically, a pair of slide guides 15, 15 are provided in the housing 13 as shown in Fig. 5. Each slide guide 15 is formed into a vertical wall-shape provided to stand on a bottom portion of the housing 13 and extends along the axial line Lc perpendicular to the plane of paper of Fig. 5. The two slide guides 15, 15 face each other in a direction perpendicular to the axial line Lc (a left-and-right direction in Fig. 5). The holding member 50 is placed on these slide guides 15, 15 so that the holding member 50 can be horizontally slid. A pair of engaging pieces 54, 54 are cut and raised from the lower holding plate 52 so as to extend toward the lower direction. Each engaging piece 54 is hooked on an upper end portion of the corresponding slide guide 15. With this configuration, a slide direction of the holding member 50 is restricted to only a direction along the axial line Lc.

[0032] As shown in Fig. 7, the screw member 44 abuts against the back plate 53. As shown in Fig. 7(a) and 7(b), the holding member 50 is pushed due to the screwing of the screw member 44 and the holding member 50 is slid (the position of the holding member 50 is adjusted) toward the outer circumferential direction (a diagonal lower

direction in Fig. 7) along the axial line Lc. Further, when the screw member 44 is loosened, the holding member 50 is pushed back by the tension of the endless connecting body 30 and the holding member 50 is slid (the position of the holding member 50 is adjusted) toward the inner circumferential direction (a diagonal upper direction in Fig. 7) along the axial line Lc.

[0033] Namely, the screw member 44 and the holding member 50 are engaged with each other so as to allow rotary torque applied to the screw member 44 to be converted to the sliding of the holding member 50.

[0034] As shown in Fig. 3, the four intermediate bodies 41, 42 are held by the holding member 50 in a state that the four intermediate bodies 41, 42 are put between the holding plates 51, 52. These intermediate bodies 41, 42 are arranged so that their axial lines are directed in the vertical direction and the intermediate bodies 41, 42 can be rotated with respect to the holding member 50 around their own axes. As shown in Fig. 6(b), a shaft pin 41p for the first intermediate body 41 is undetachably coupled with the holding plates 51, 52 with a caulking method or the like. This results in that the first intermediate body 41 is undetachable with respect to the holding member 50. As shown in Fig. 2, the two intermediate bodies 41, 41 are respectively arranged on both sides across the axial line Lc.

[0035] The second intermediate body 42 is arranged nearer to the outer circumferential side of the curved portion 10c of the arm 10 (the diagonal lower side in Fig. 2) than the first intermediate body 41. As shown in Fig. 6(b), a shaft pin 42p for the second intermediate body 42 can be inserted into and removed from the holding member 50. This results in that the second intermediate body 42 can be attached to and detached from the holding member 50. As shown in Fig. 2, the two intermediate bodies 42, 42 are respectively arranged on both sides across the axial line Lc. A space between the second intermediate bodies 42, 42 is narrower than a space between the first intermediate bodies 41, 41.

[0036] As shown in Fig. 2, the first bridging portion 31 of the endless connecting body 30 passes between the first intermediate bodies 41 and the second intermediate bodies 42 in the holding member 50. An outer circumferential surface of the first bridging portion 31 makes contact with the first intermediate bodies 41. Further, the first bridging portion 31 is wound over the first intermediate bodies 41 and thereby the first bridging portion 31 is curved so as to follow the bend angle of the curved portion 10c.

[0037] The second intermediate bodies 42, 42 are arranged between the first bridging portion 31 and the second bridging portion 32 of the endless connecting body 30. These second intermediate bodies 42 make contact with an inner circumferential surface of the second bridging portion 32 and the meshing portions 42a mesh with the meshing portion 30a of the second bridging portion 32. The second bridging portion 32 is wound over the second intermediate bodies 42 and thereby the second

bridging portion 32 is curved so as to follow the bend angle of the curved portion 10c.

[0038] As shown in Fig. 7, the intermediate bodies 41, 42 are configured so that the intermediate bodies 41, 42 can be slid (the positions of the intermediate bodies 41, 42 can be adjusted) with respect to the arm 10 in the direction along the axial line Lc due to the sliding of the holding member 50. Due to the positional adjustment of the first intermediate bodies 41, the first bridging portion 31 is tensed or loosened. Due to the positional adjustment of the second intermediate bodies 42, the second bridging portion 32 is tensed or loosened. In addition, due to the sliding of the holding member 50, the positions of the intermediate bodies 41, 42 are integrally adjusted. Thus, both of the bridging portions 31, 32 are simultaneously tensed or loosened.

[0039] The holding member 50 serves as transmission means for simultaneously transmitting pushing force (actuating force) of the screw member 44 to the intermediate bodies 41, 42.

[0040] The hinge device 3 is assembled according to the following steps.

[0041] As shown in Fig. 3, the first rotating body 21 is contained in the first end portion 11 of the housing 13. Further, the second rotating body 22 is contained in the second end portion 12 of the housing 13.

[0042] Next, the endless connecting body 30 is contained in the housing 13 and wound around between the rotating bodies 21, 22. In this stage, the tension applying means 40 is not mounted on the housing 13 and thus the endless connecting body 30 is in a loose state. Namely, it is not necessary to wind the endless connecting body 30 around between the rotating bodies 21, 22 in a state that the endless connecting body 30 is in a tensed state. Thus, it is possible to easily perform an attaching operation for the endless connecting body 30.

[0043] In this regard, the screw member 44 of the tension applying means 40 may be shallowly screwed into the screw hole 10d in advance (Fig. 7(a)).

[0044] Next, the first rotating body 21 is coupled with the housing-side attachment member 23 through the attachment plate 21b and the attachment pins 21p to fix the first rotating body 21. Further, the second rotating body 22 is coupled with the door-side attachment member 24 through the attachment plate 22b and the attachment pins 22p to fix the second rotating body 22.

[0045] Next, the tension applying means 40 is attached to the arm 10. At this time, the second intermediate bodies 42 are removed from the holding member 50 in advance. In this regard, the first intermediate bodies 41 are undetachably attached to the holding member 50 as described above.

[0046] This holding member 50 is contained in the housing 13. Then, the first bridging portion 31 of the endless connecting body 30 is inserted between the holding plates 51, 52 to abut the first intermediate bodies 41 against the outer circumferential surface of the first bridging portion 31.

[0047] Subsequently, the second intermediate bodies 42 are inserted between the holding plates 51, 52 and arranged between the first bridging portion 31 and the second bridging portion 32 of the endless connecting body 30. These second intermediate bodies 42 are rotatably attached to the holding member 50 through the shaft pins 42p. In addition, the meshing portions 42a are meshed with the meshing portion 30a of the second bridging portion 32.

[0048] Since the endless connecting body 30 is in the loose state, it is possible to easily perform the above-described attaching operation for the tension applying means 40.

[0049] Next, as shown in Fig. 7(b), the screw member 44 is screwed toward the inside of the housing 13 to push and move the holding member 50 toward the outer circumferential side of the curved portion 10c along the axial line Lc. With this operation, the intermediate bodies 41, 42 are integrally slid (the positions of the intermediate bodies 41, 42 are integrally adjusted) toward the outer circumferential side of the curved portion 10c along the axial line Lc. Thus, the first bridging portion 31 and the second bridging portion 32 are simultaneously tensed by the substantially same amount. Therefore, the tension of the substantially same amount can be applied to these bridging portions 31, 32, thereby preventing imbalance of the tension from occurring between the bridging portions 31, 32. With this configuration, it is possible to prevent or suppress the second rotating body 22 from being rotated with respect to the arm 10 when the tension is applied to the endless connecting body 30 and thus it is possible to prevent or suppress the door 2 from being rotated with respect to the housing 1. Therefore, it is possible to fitly close the door 2 at the time when the door 2 is full-closed (Fig. 1 and Fig. 8(a)).

[0050] After that, the cover 14 is put on the housing 13 to cover the housing 13. In this regard, this attachment for the cover 14 may be performed after the holding member 50 is attached and before the tension is applied to the endless connecting body 30.

[0051] According to this hinge device 3, it is possible to reliably connect the rotating bodies 21, 22 with each other by applying appropriate tension to the endless connecting body 30. Thus, it is possible to reliably rotate the two rotating bodies 21, 22 with respect to the arm 10 in synchronization with each other at the time of opening and closing the door 2, thereby allowing the door 2 to be always directed toward the front side regardless of a degree of opening.

[0052] Next, another embodiment of the present invention will be described. In the following embodiment, the same configurations as these of the already-described embodiment are denoted with the same signs in the drawings and description for the same configurations will be omitted.

[Second embodiment]

[0053] Fig. 9 shows a second embodiment of the present invention. Tension applying means 40B of the second embodiment includes only one first intermediate body 41 and only one second intermediate body 42. These intermediate bodies 41, 42 are arranged so as to align on the axial line Lc of the screw member 44. Thus, an aligning direction of the intermediate bodies 41, 42 coincides with a slide direction of a holding member 50B, that is a slide direction of the intermediate bodies 41, 42. A width of the holding member 50B is narrower than a width of the holding member 50 of the first embodiment. A space between the slide guides 15, 15 is narrower than that in the first embodiment.

[0054] The present invention is not limited to the above-described embodiments and a variety of modifications can be applied to the present invention as long as it is not contrary to the spirit of the present invention.

[0055] For example, the screw member 44 may be provided so that the screw member 44 can be rotated with respect to the arm 10 around the axial line Lc and cannot be displaced in the direction along the axial line Lc and may be screwed with the holding member 50, 50B.

[0056] It may be possible to take a configuration in which the screw member 44 is provided on the side wall on the outer circumferential side (the lower side in Fig. 7) of the curved portion 10c of the arm 10 and the tension is applied to the endless connecting body 30 when the holding member 50, 50B is pulled toward the outer circumferential side by the screw member 44.

[0057] The adjusting member is not limited to the screw member 44 and may include a lever, a nob and the like.

[0058] The adjusting member may include biasing means such as a coil spring. The holding member 50, 50B may be slid by bias force (actuating force) of the biasing means to apply the tension to the endless connecting body 30.

[0059] A spring insertion hole may be formed in the side wall of the curved portion 10c of the arm 10. The endless connecting body 30 and the holding member 50, 50B may be contained in the arm 10 and then the coil spring may be inserted into the arm 10 through the spring insertion hole to bias the holding member 50, 50B toward the slide direction. A female screw may be engraved on an inner circumferential surface of the spring insertion hole and this female screw may be screwed with a screw member. Further, a tip end portion of this screw member may be abutted against an end portion of the coil spring on an opposite side of the side of the holding member 50, 50B to use reactive force of the coil spring.

[0060] It may be possible to take a configuration in which the positions of the first intermediate body 41 and the second intermediate body 42 are individually adjusted. Adjusting means 43 for the first intermediate body 41 and adjusting means 43 for the second intermediate body 42 may be separately provided.

[0061] The adjusting means 43 may have a cam. The

cam may be intervened between the adjusting member such as the screw member 44 and the intermediate bodies 41, 42 as transmission means. Actuating force inputted into the adjusting member such as the screw member 44 may be converted to sliding force for the intermediate bodies 41, 42 by using the cam.

[0062] The slide direction of the first intermediate body 41 may be different from the slide direction of the second intermediate body 42.

[0063] Actuating force inputted to one adjusting member may be distributed to the intermediate bodies 41, 42 by using the cam to respectively slide the intermediate bodies 41, 42 in different directions.

[0064] It may be possible to take a configuration in which the first intermediate body 41 makes contact with the outer circumferential surface of the first bridging portion 31, the second intermediate body 42 makes contact with the outer circumferential surface of the second bridging portion 32 and these intermediate bodies 41, 42 can be slid in a direction in which the intermediate bodies 41, 42 get close to or separate from each other. In this configuration, the tension is applied to the bridging portions 31, 32 due to the sliding for getting the intermediate bodies 41, 42 close to each other and the bridging portions 31, 32 are loosened due to the sliding for separating the intermediate bodies 41, 42 from each other.

[0065] It may be possible to take a configuration in which the first intermediate body 41 makes contact with the inner circumferential surface of the first bridging portion 31, the second intermediate body 42 makes contact with the inner circumferential surface of the second bridging portion 32 and these intermediate bodies 41, 42 can be slid in a direction in which the intermediate bodies 41, 42 get close to or separate from each other. In this configuration, the tension is applied to the bridging portions 31, 32 due to the sliding for separating the intermediate bodies 41, 42 from each other and the bridging portions 31, 32 are loosened due to the sliding for getting the intermediate bodies 41, 42 close to each other.

[0066] The arm 10 is not necessarily curved into the dogleg shape (the L shape) and may straight extend.

[0067] Instead of the belt, a roller chain may be used as the endless connecting body 30.

[0068] Instead of the roller or the pulley, a sprocket may be used as the intermediate bodies 41, 42.

[0069] It may be possible to take a configuration in which the intermediate body 41 is not rotated and is fixed to the arm 10. The endless connecting body 30 may be configured to slide on the circumferential surface of the intermediate body 41. In the same manner, it may be possible to take a configuration in which the intermediate body 42 is not rotated and is fixed to the arm 10. The endless connecting body 30 may be configured to slide on the circumferential surface of the intermediate body 42.

[0070] The gear ratio of the first rotating body 21 and the second rotating body 22 is not necessarily one. It may be possible to take a configuration in which the rotating

bodies 21, 22 rotate with respect to the arm 10 with different speeds. It may be possible to take a configuration in which the direction of the door 1 with respect to the housing 1 is changed depending on the degree of opening.

[0071] The hinge device 3 is not limited to the container device M and can be applied to a hinge portion in an electric device, a vehicle or the like.

INDUSTRIAL APPLICABILITY

[0072] The present invention can be applied to a hinge of a door of a container device, for example.

[0073]

- 1 Housing (first member)
- 2 Door (second member)
- 3 Hinge device
- 10 Arm
- 11 First end portion
- 12 Second end portion
- 21 First rotating body
- 22 Second rotating body
- 30 Endless connecting body
- 31 First bridging portion
- 32 Second bridging portion
- 40, 40B Tension applying means
- 41 First intermediate body
- 42 Second intermediate body
- 43 Adjusting means
- 44 Screw member (adjusting member)
- 50, 50B Holding member (transmission means)

Claims

1. A hinge device for coupling a second member with a first member so that the second member can be relatively moved with respect to the first member, the hinge device comprising:

an arm;
 a first rotating body rotatably provided in a first end portion of the arm in a lengthwise direction of the arm and fixed to the first member;
 a second rotating body rotatably provided in a second end portion opposite to the first end portion of the arm and fixed to the second member;
 an endless connecting body for connecting the first and second rotating bodies with each other so that the first and second rotating bodies can be rotated with respect to the arm in the same direction, the endless connecting body having two wound portions respectively wound around the first and second rotating bodies and first and second bridging portions each bridged between the first and second rotating bodies and being formed into an endless shape; and

tension applying means for applying tension to the endless connecting body,
 wherein the tension applying means includes:

a first intermediate body which makes contact with the first bridging portion and can be slid with respect to the arm in a direction for tensing or loosening the first bridging portion,
 a second intermediate body which makes contact with the second bridging portion and can be slid with respect to the arm in a direction for tensing or loosening the second bridging portion, and
 adjusting means for adjusting positions of the first and second intermediate bodies in a slide direction of each of the first and second intermediate bodies.

2. The hinge device as claimed in claim 1, wherein the adjusting means includes:

one adjusting member to which actuating force for the positional adjustment is inputted, and transmission means for simultaneously transmitting the actuating force to the first and second intermediate bodies.

3. The hinge device as claimed in claim 2, wherein the first intermediate body makes contact with an outer circumferential surface of the first bridging portion, wherein the second intermediate body makes contact with an inner circumferential surface of the second bridging portion, wherein the transmission means includes a holding member for holding the first intermediate body and the second intermediate body and the holding member is slidably provided in the arm, and wherein a position of the holding member is adjusted by the adjusting member.

FIG. 1

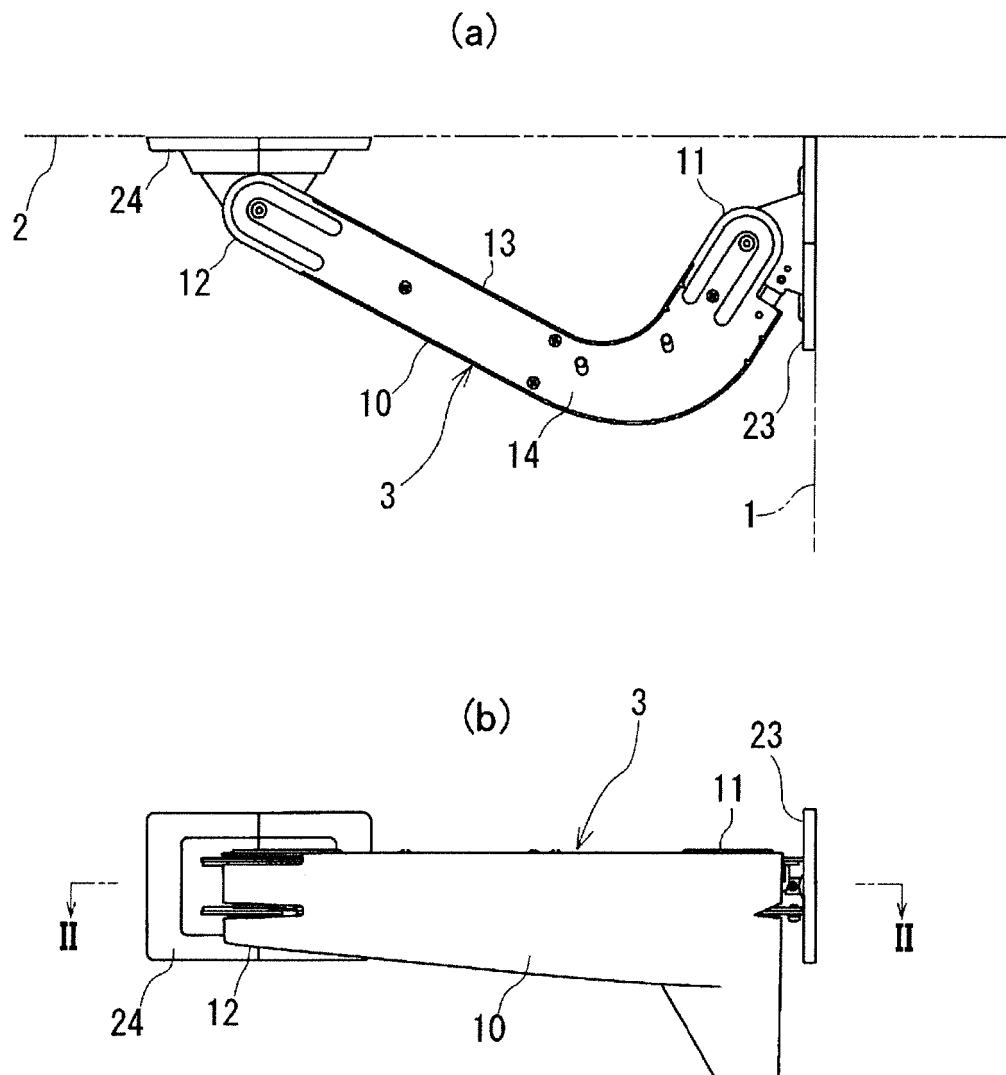


FIG. 2

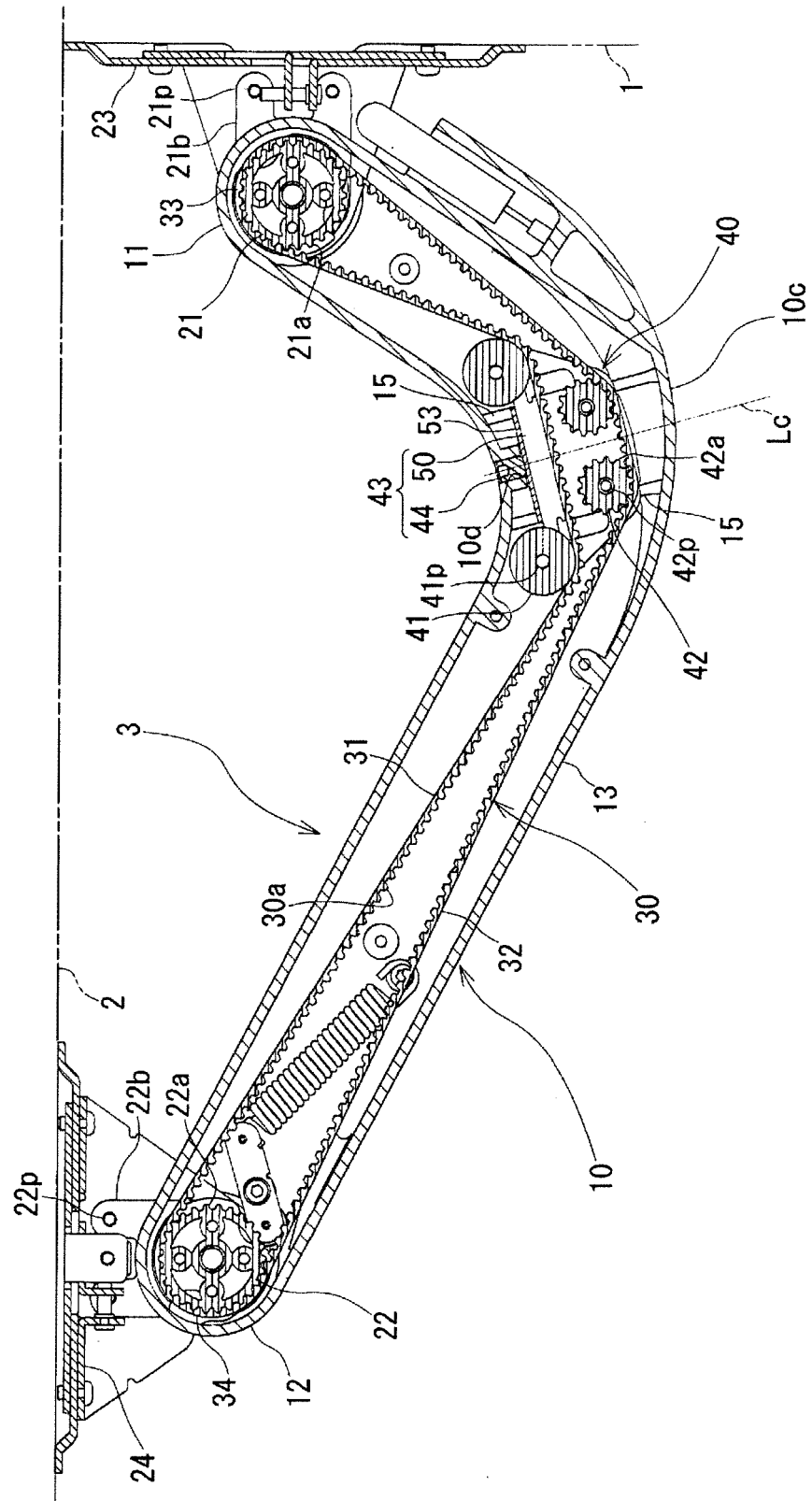


FIG. 3

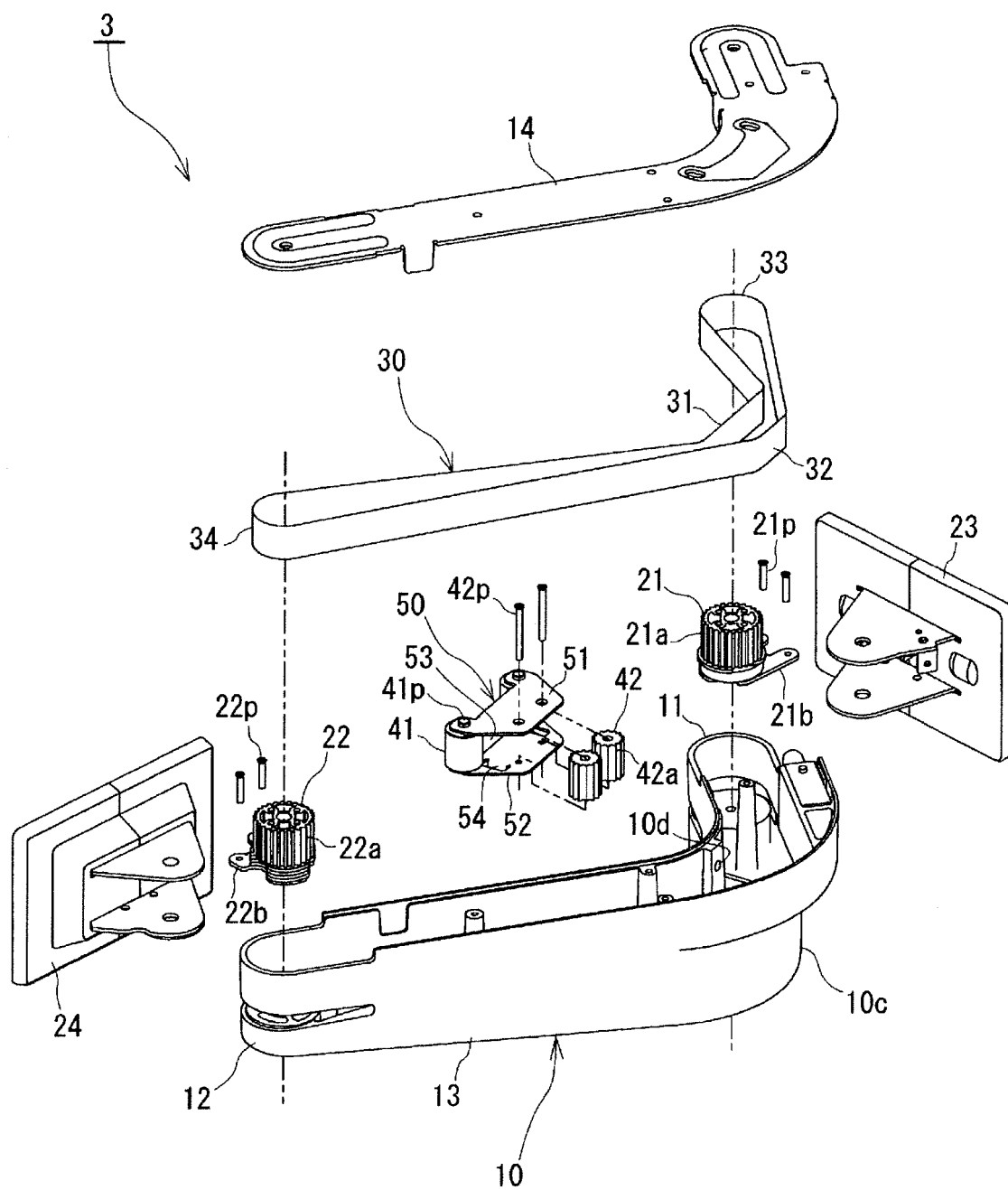


FIG. 4

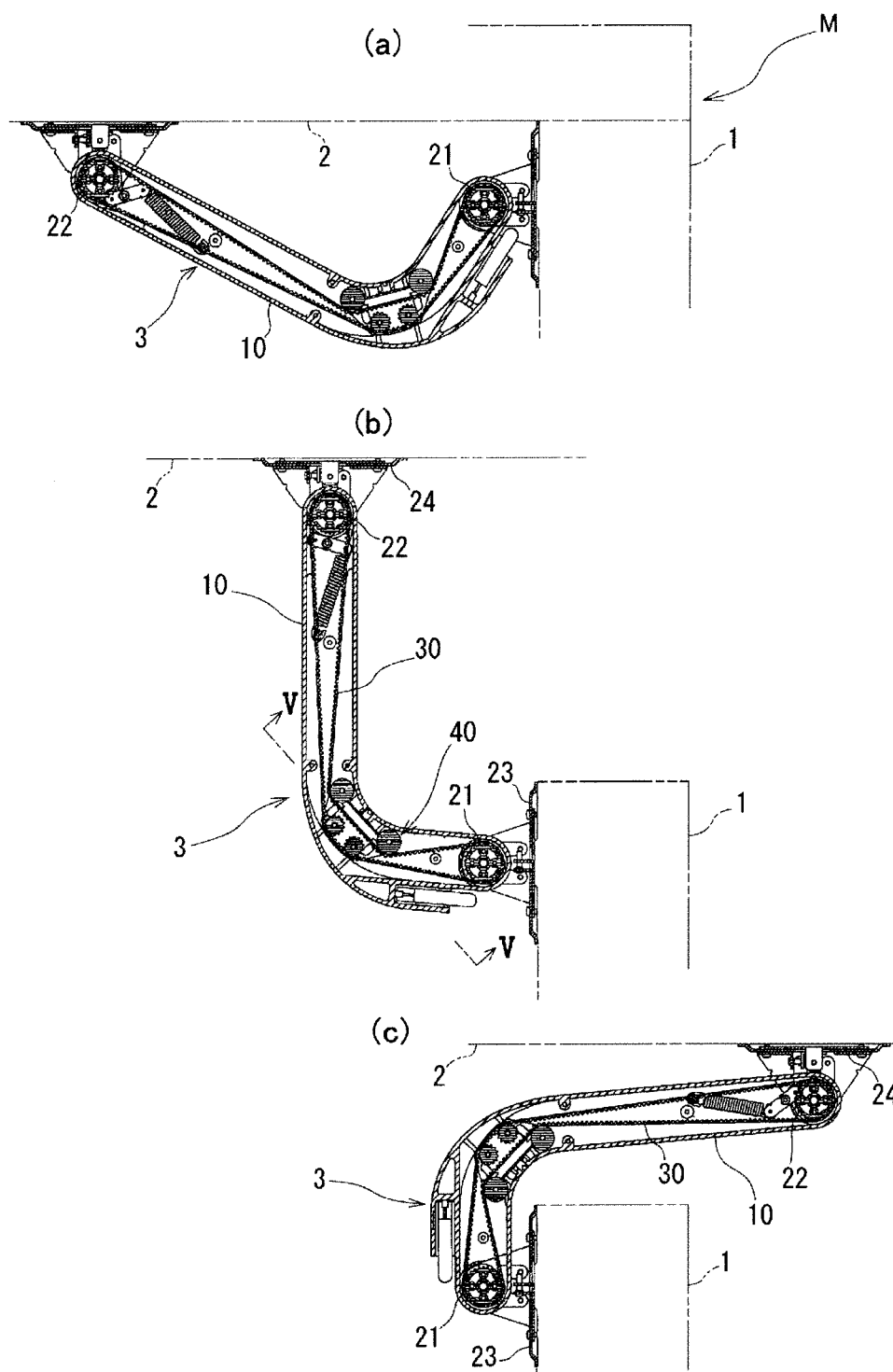


FIG. 5

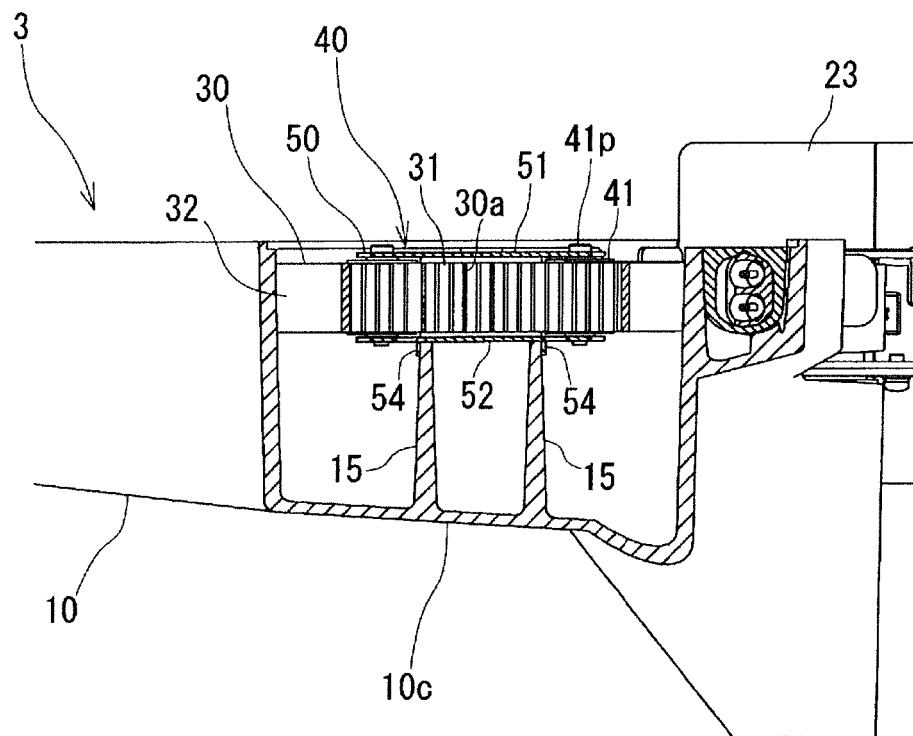
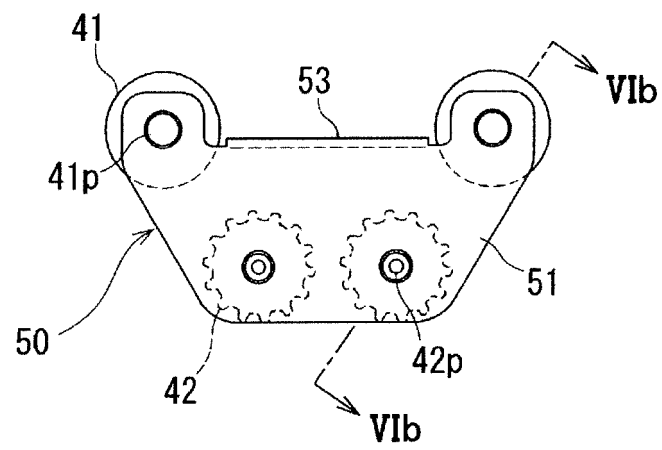


FIG. 6

(a)



(b)

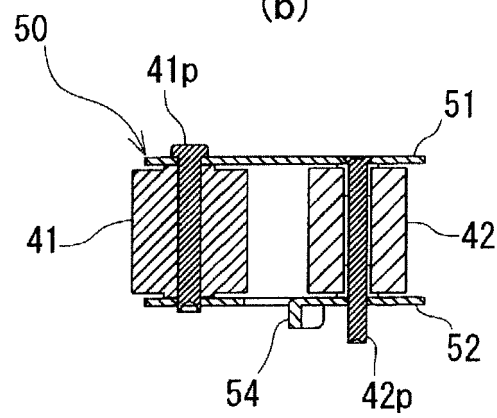


FIG. 7

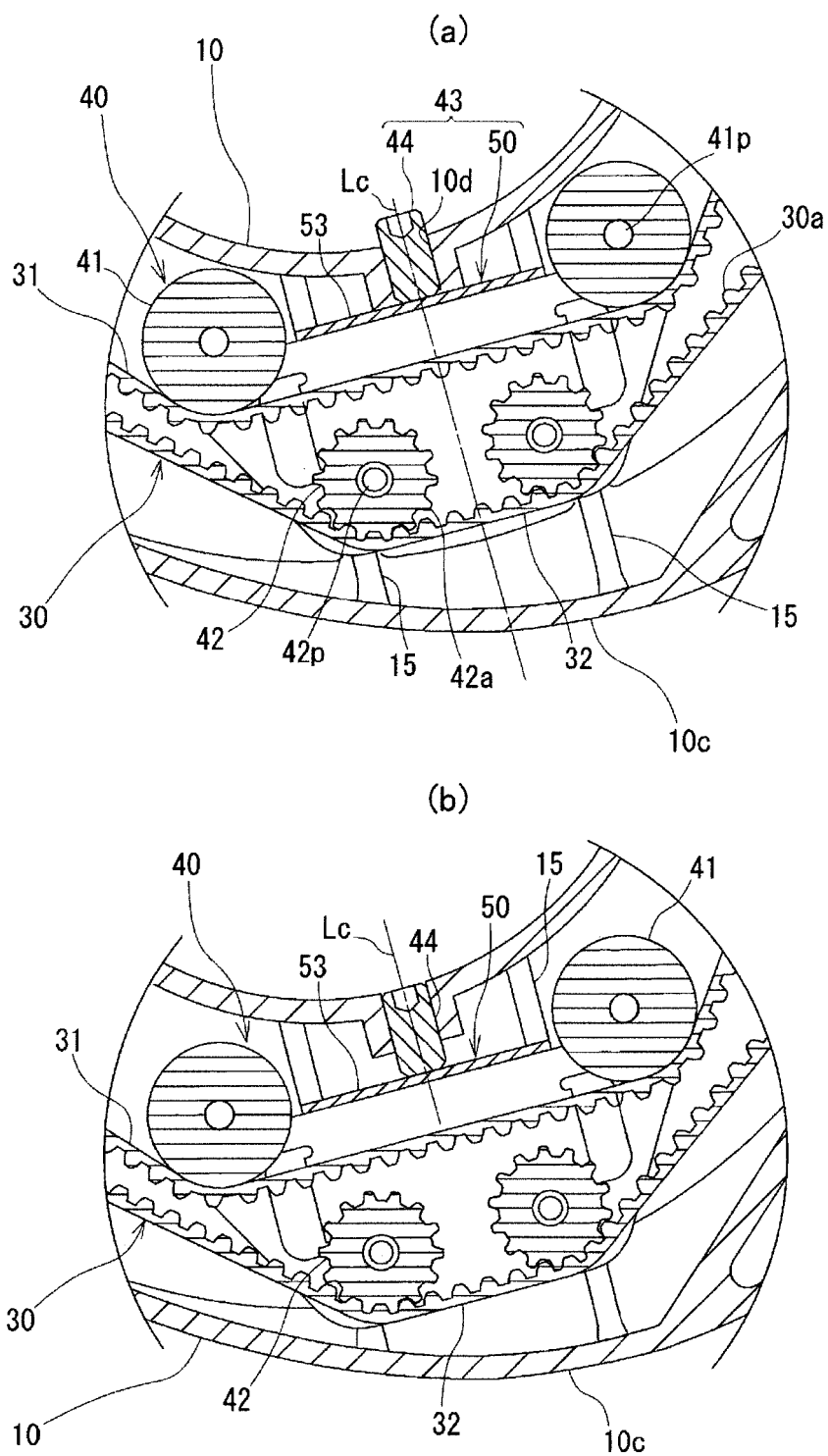


FIG. 8

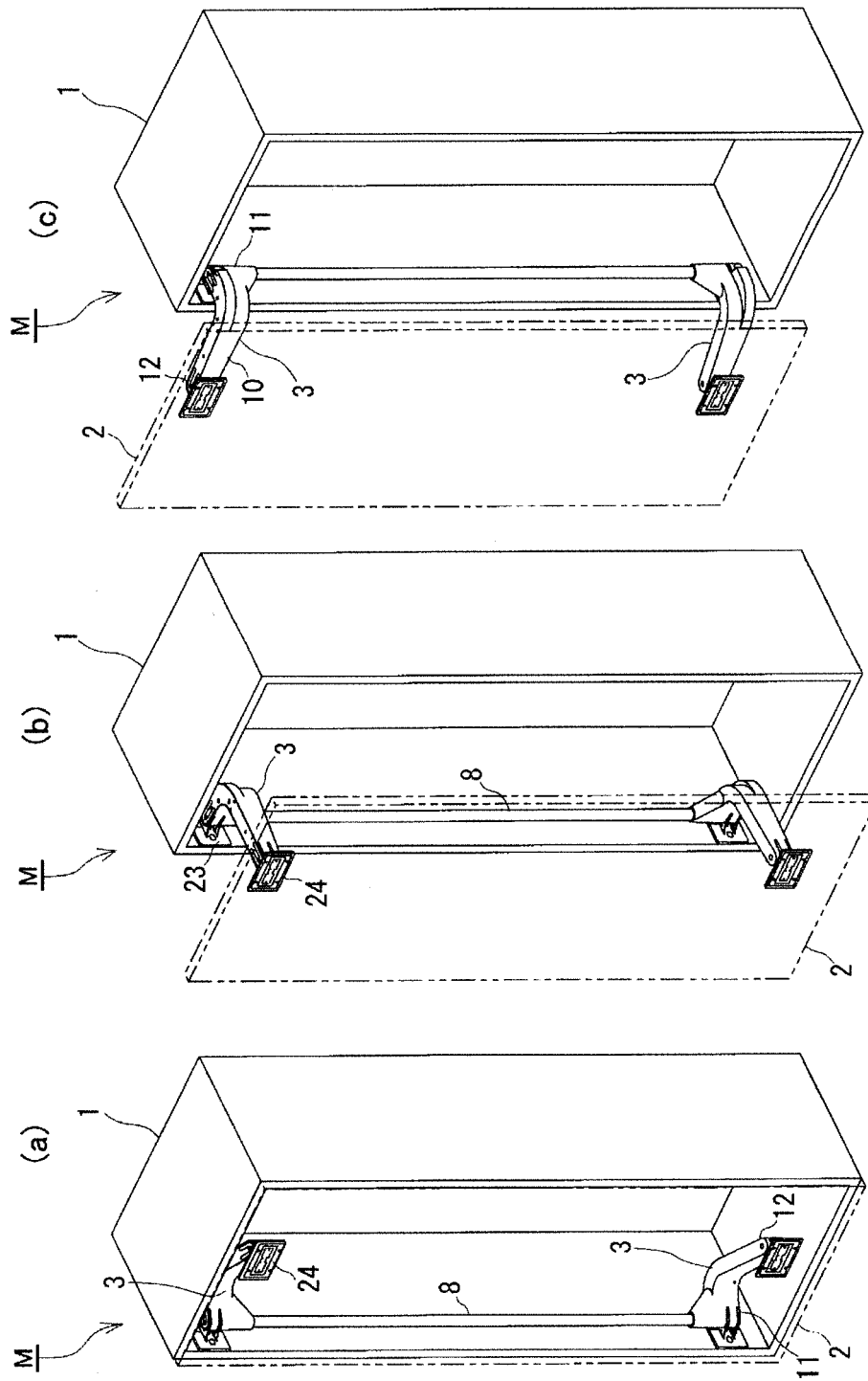
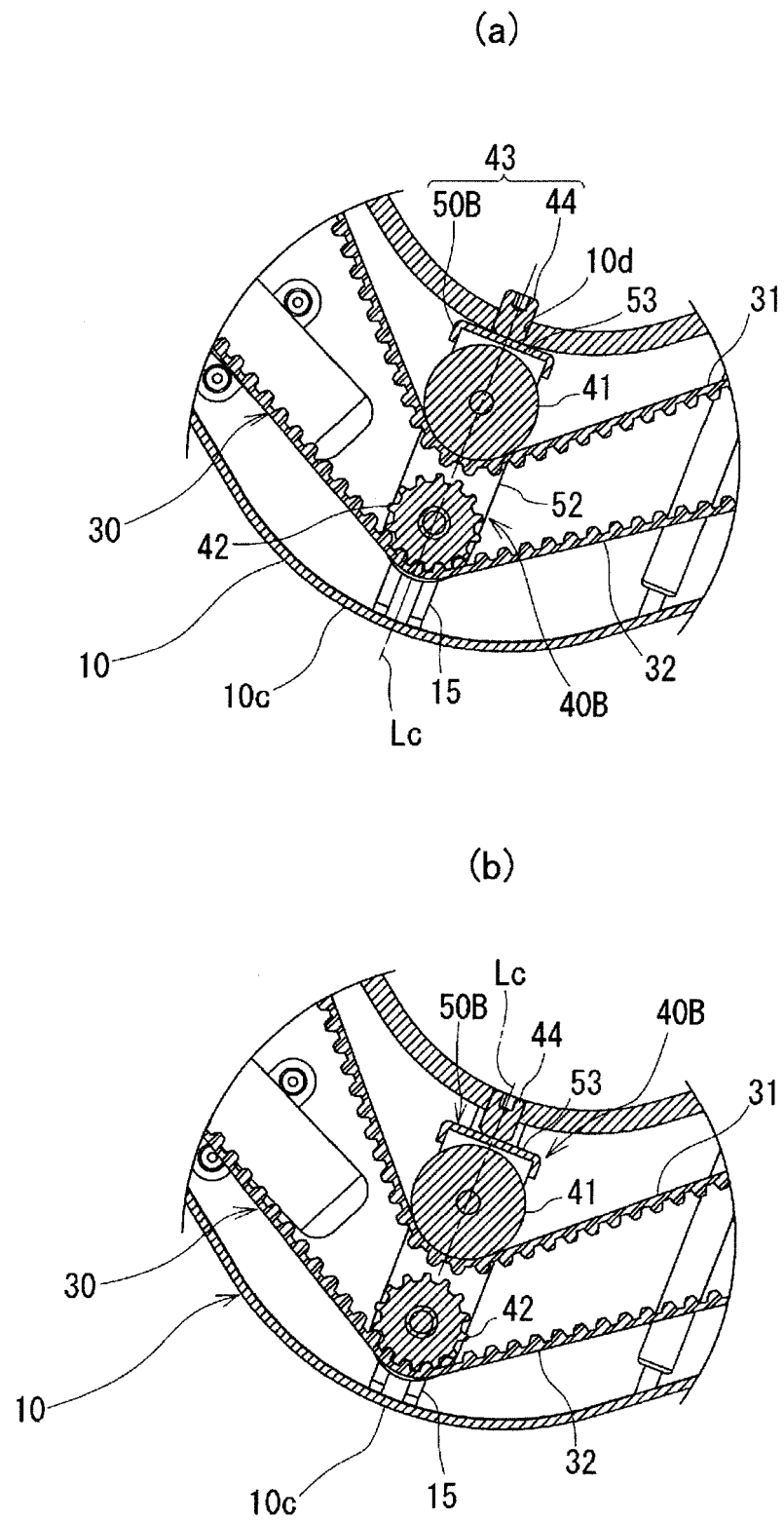


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/056524

A. CLASSIFICATION OF SUBJECT MATTER

E05D3/12(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)

E05D3/12

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 1996-2016

Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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.
Y	JP 2006-526719 A (Adam Opel AG), 24 November 2006 (24.11.2006), paragraphs [0023] to [0028]; fig. 3, 4 & US 2007/0084016 A1 paragraphs [0041] to [0047]; fig. 3, 4 & DE 10325232 A1 & CN 1791729 A	1-3
Y	JP 2001-20607 A (Itoki Crebio Corp.), 23 January 2001 (23.01.2001), paragraph [0033]; fig. 8 (Family: none)	1-3

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

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"&" document member of the same patent family

Date of the actual completion of the international search

10 May 2016 (10.05.16)

Date of mailing of the international search report

24 May 2016 (24.05.16)

Name and mailing address of the ISA/

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Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 5289615 B [0004]