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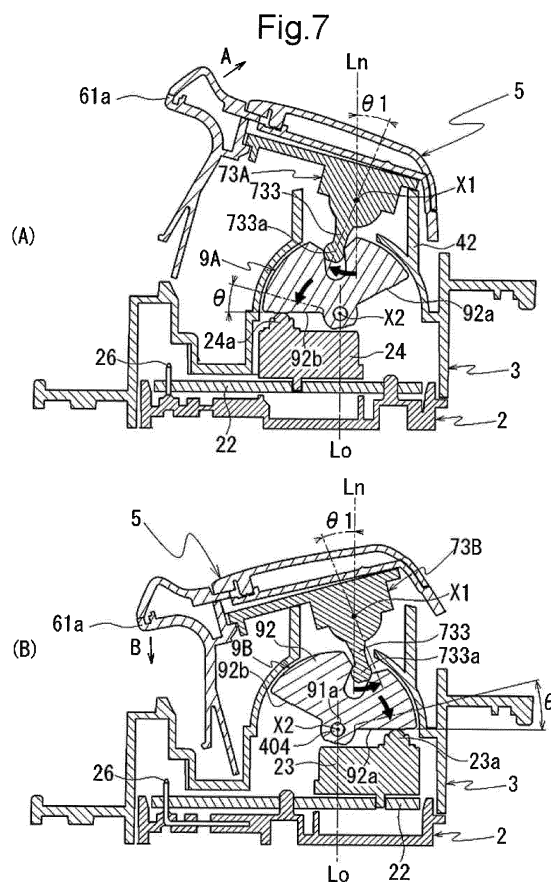
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(54) **Switch device**

(57) First and second cams (9A,B) are rotated in a direction determined by a rotation direction of a knob (5) by first and second operation portions (73A,B) extending from the knob (5). A first switch element (23) is switched on when the first cam is rotated in one direction around the second shaft (X2), by a pressing portion (92) of the first cam at one side thereof. A second switch element is switched on when the second cam is rotated in the other direction around the second shaft (X2), by a pressing portion (92) of the second cam at the other side thereof. As viewed in a shaft direction of the rotary shaft (X2), (a) the first and second switch elements (23,24) and (b) the pressing portions (92,b) are respectively arranged to be symmetrical around the second shaft (X2).



Description

[0001] The present invention relates to a switch device that is configured to rotate a knob around a rotary shaft of the knob for switching on a switch element.

Description of the Related Art

[0002] Japanese Patent Laid-Open Publication No. 2006-315468 discloses a parking brake device that is configured such that when a push type button is operated, an actuator is driven to switch on a parking brake.

[0003] The parking brake device disclosed in Japanese Patent Laid-Open Publication No. 2006-315468 is not configured in such a manner as to switch on the parking brake by pulling a lever as in the case of the conventional brake device. Therefore there are some cases where, for people who are used to an operation in the conventional parking brake device, the operation at the time of switching on the parking brake in the parking brake device disclosed in Japanese Patent Laid-Open Publication No. 2006-315468 causes a strange feeling.

[0004] Therefore, for making the operation feeling at the time of switching the parking brake closer to that in the conventional parking brake device, there is proposed a parking brake device in which a knob that is rotatable around one shaft is operated instead of the push type button, thereby causing the parking brake to switch on.

[0005] Figs. 8A, 8B and 8C are diagrams explaining the configuration of a switch device 100 in a parking brake device that is constructed to employ a knob 101 rotatable around one shaft for causing the parking brake to switch on. Fig. 8A is a diagram showing a cutaway cross section of the switch device 100 in a direction perpendicular to a rotary shaft X of the knob 101, Fig. 8B is a diagram showing a state where one switch element 105 of switch elements 105 and 106 is switched on by a rotational operation of the knob 101, and Fig. 8C is a diagram explaining an operation amount of the knob 101 in case of a switch device 100' in which the rotary shaft X of the knob 101 is provided to be closer to a base portion 101b of the knob 101 at the opposite side to an operation portion 101a thereof.

[0006] As shown in Fig. 8A, the switch device 100 is provided with the knob 101 that is supported by a cover 102 to be able to rotate around the rotary shaft X of the knob 101. When a side of the operation portion 101a of the knob 101 is operated in a pulling-up direction (direction of an arrow A in Fig. 8A) from a reference position shown in Fig. 8A, a moving block 103 that is provided in a side of base portion 101b of the knob 101 rotates downward to a side of a base plate 107, thus causing the switch element 105 to switch on (refer to Fig. 8B). In addition, when the side of the operation portion 101a of the knob 101 is operated in a pushing-in direction (direction of an arrow B in Fig. 8A) from the reference position, a moving block 104 that is provided in the side of the base portion 101a of the knob 101 rotates downward to the side of the

base plate 107, thus causing a switch element 106 to switch on.

[0007] In the parking brake device provided with this switch device 100, in a case where the switch element 105 is switched on, a control device (not shown) drives an actuator (not shown) to switch on the parking brake, and in a case where the switch element 106 is switched on, the parking brake is switched off.

[0008] According to this switch device 100, the rotary shaft X of the knob 101 is positioned in a substantially central portion of the knob 101 in the longitudinal direction (right-left direction in Fig. 8A), and the operation portion 101a at one side and the base portion 101b at the other side that are positioned at both sides on a basis of the rotary shaft X are provided in a positional relation of being symmetrical around the rotary shaft X. Therefore even if the side of the base portion 101b of the knob 101 is operated in a pushing-down direction (refer to an arrow C in Fig. 8B), the side of the operation portion 101a of the knob 101 rotates in the pulling-up direction (refer to an arrow A in the figure) to switch on the switch element 105, so that the parking brake is switched on.

[0009] Here, for not involving the side of the base portion 101b of the knob 101 in an on/off operation of the parking brake, there is considered the configuration in which the rotary shaft X of the knob 101 is provided in a position closer to the base portion 101b to involve only the side of the operation portion 101a of the knob 101 in the on/off operation of the parking brake (refer to Fig. 8C). In this case, however, an operation amount (refer to a code α in the figure) in a case of switching on the switch element 105 by operating the side of the operation portion 101a of the knob 101 in the pulling-up direction is larger than an operation amount (refer to a code β in the figure) in a case of switching on the switch element 106 by operating the side of the operation portion 101a of the knob 101 in the pushing-down direction.

[0010] As a result, since the operation amount of the knob required for switching on the switch element differs depending on the operation direction of the knob 101, there is a possibility that an operator has a strange feeling in the operation feeling of the knob 101.

[0011] Therefore, there is a demand for a switch device with the configuration that even if the rotary shaft of the knob is set to one side of the knob in the longitudinal direction, the operation amount of the knob required for switching on the switch element does not differ depending on the operation direction.

SUMMARY OF THE INVENTION

[0012] Accordingly, the present invention is made in view of the above-described problems in the conventional switch device. A preferred embodiment of the present invention may provide a switch device in which an operation of a knob required for switching on a switch element does not differ depending on an operation direction of the knob.

[0013] According to an aspect of the present invention, a switch device comprises:

a knob that is provided to be rotatable around a first shaft;
 a cam that is provided to be rotatable around a second shaft and is rotated from a reference position in a predetermined direction determined corresponding to a rotational direction of the knob by an operation element extending from the knob;
 a first switch element that, when the cam is rotated in one direction around the second shaft, is switched on by a pressing portion of the cam at one side thereof; and
 a second switch element that, when the cam is rotated in the other direction around the second shaft, is switched on by a pressing portion of the cam at the other side thereof, wherein
 as viewed in a shaft direction of the rotary shaft of the cam, the first switch element and the second switch element, and the pressing portion at the one side and the pressing portion at the other side thereof are respectively arranged to be symmetrical around the second shaft.

[0014] According to the aspect of the present invention, since a rotational angle of the cam from the reference position at the time of switching on the first switch element is equal to that of the cam from the reference position at the time of switching on the second switch element, a rotational angle of the knob at the time of rotating the cam by the operation element also becomes the same in both of a case of switching on the first switch element and of a case of switching on the second switch element. Therefore, even if the rotary shaft of the knob is set to the one side of the knob in the longitudinal direction, in any of a case of switching on the first switch element and of a case of switching on the second switch element, the rotational angle of the knob becomes the same. Accordingly, the operation amount of the knob can be controlled not to differ depending on the operation direction of the knob.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Other objects, features, and advantages of the present invention will become more apparent from the following detailed description made with reference to the accompanying drawings, in which like parts are designated by like reference numbers and in which:

Fig. 1 is an exploded perspective view showing a switch device according to an embodiment in the present invention;
 Figs. 2A, 2B and 2C are diagrams explaining a cover according to the embodiment;
 Fig. 3 is a cross section showing the switch device according to the embodiment;

Figs. 4A and 4B are diagrams explaining a connecting portion according to the embodiment;

Fig. 5 is a cross section showing the switch device according to the embodiment;

Fig. 6 is a cross section showing the switch device according to the embodiment;

Figs. 7A and 7B are diagrams each explaining an operation of the switch device according to the embodiment; and

Figs. 8A, 8B and 8C are cross sections each showing a conventional switch device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Hereinafter, a switch device according to an embodiment in the present invention will be explained with reference to the accompanying drawings. Fig. 1 is an exploded perspective view of a switch device 1 according to an embodiment in the present invention. The switch device 1 is provided with a polar board (or printed circuit board) 2, a cover 3, and a knob 5. When the knob 5 is operated, cam 9 (9A or 9B) supported by the cover 3 is rotated to switch on one of switch elements 23 and 24 provided in a side of the polar board 2 by one of the cams 9A and 9B. Here, in the following explanation, in Fig. 1 a side of the knob 5 is indicated as upward, and a side of the polar board 2 is indicated as downward for descriptive purposes.

[0017] The polar board 2 is provided with a rectangular base portion 21 in a plan view, and a rectangular print substrate 22 is provided on a top face of the base portion 21 in a side of the cover in a plan view. Push type switch elements 23 and 24 are provided on a top face of the print substrate 22 in the side of the cover 3 respectively in positions closer to one side in the longitudinal direction of the print substrate 22, and the switch elements 23 and 24 are provided to be spaced from each other in the width direction of the print substrate 22. The switch elements 23 and 24 each are formed in a rectangular shape in a plan view, and are respectively provided with operated portions 23a and 24a that project upward in a side of the cover 3 at each side of the longitudinal direction. The switch elements 23 and 24 are provided with the operated portions 23a and 24a that are positioned to be the most separated from each other in the longitudinal direction of the print substrate 22, and when the operated portion 23a or 24a is pushed down to a side of the print substrate 22, the switch element 23 or 24 corresponding to the pushed operated portion 23a or 24a is switched on.

[0018] One-end sides of a plurality of terminals 26 that project upward from the polar board 2 are connected to the print substrate 22 in a position closer to the other side in the longitudinal direction to project upward from the polar board 2, and these terminals 26 are connected to the switch elements 23 and 24, and the like through unillustrated wires (or conductive paths) provided on the print substrate 22. These terminals 26 are embedded in

the polar board 2 by insert molding, and the other-end sides of the terminals 26 are positioned within a connector portion 25 projecting downward from the base portion 21.

[0019] A plurality of locking portions 27 and engagement portions 28 are provided on an outer periphery of the base portion 21. The locking portions 27 and the engagement portions 28 respectively are, at the time of incorporating the cover 3 in the polar board 2, engaged to engagement holes 32 and engagement concave portions 33 provided in a side of the cover 3, thus preventing the cover 3 from dropping down from the polar board 2 or positioning the cover 3 to the polar board 2.

[0020] Figs. 2A, 2B and 2C are diagrams for explaining the cover 3, wherein Fig. 2A is a plan view showing the cover 3 as viewed from above in a side of the knob 5, Fig. 2B is an enlarged perspective view showing the periphery of a support portion 4 in the cover 3, and Fig. 2C is an enlarged plan view showing the periphery of the support portion 4 in the cover 3. It should be noted that in Fig. 2C, for easy understanding of the shape of the support portion 4, wall portions 41, 42, 43, 44, 45, 46 that constitute the support portion 4, and partition walls 47 and 48 are illustrated in hatching lines. Fig. 3 is a cross section showing the cover 3, taken along line A-A in Fig. 2A together with a section of other components in the switch device 1. Figs. 4A and 4B are diagrams for explaining a connecting portion 7, wherein Fig. 4A is a perspective view showing the connecting portion 7 as viewed from downward in a side of the cover 3, and Fig. 4B is a plan view showing the connecting portion 7 as viewed from downward in a side of the cover 3. Fig. 5 is a cross section taken in line A-A in Fig. 3, and Fig. 6 is a cross section taken in line B-B in Fig. 3.

[0021] As shown in Fig. 1, the cover 3 has a peripheral wall portion 31 that is fitted on an outer periphery of the base portion 21 in the polar board 2, and mounting portions 34 and 35 for mounting the switch device 1 to an opponent member are provided in one side and the other side of the cover 3 in the longitudinal direction to project from the peripheral wall portion 31. Mounting holes 34a, 34b and 35a are, as shown in Fig. 2A, provided to penetrate through the mounting portions 34 and 35 in the thickness direction for insert of fixing bolts and projections for positioning the opponent member.

[0022] The support portion 4 that rotatably supports the knob 5 is formed inside the peripheral wall portion 31 to project upward closer to a side of the knob 5 than the peripheral wall portion 31, and the support portion 4 is provided in a position closer to the mounting portion 34 in the cover 3. As shown in Figs. 2A and 2C, the support portion 4 is provided with the wall portions 41 and 42 that extend in the width direction of the cover 3, and the wall portions 43, 44, 45 and 46 that connect the wall portions 41 and 42 with each other. The wall portions 43, 44, 45 and 46 are provided in parallel to each other to be spaced by an equal interval in the width direction of the cover 3.

[0023] The wall portions 43 and 44 that are positioned

in both sides in the width direction of the cover 3 respectively connect both ends of the wall portions 41 and 42 with each other, and an outer peripheral wall of the support portion 4 formed in a rectangular shape in a plan view are configured with the wall portions 41 and 42, and the wall portions 43 and 44.

[0024] As shown in Fig. 2B, bearing portions 431, 441, 451 and 461 are provided in the respective central parts of the wall portions 43, 44, 45 and 46 in the longitudinal direction, and respectively are provided with slits 433, 443, 453 and 463 at both sides thereof. The bearing portions 431, 441, 451 and 461 are provided to project upward closer to a side of the knob 5 than the wall portions 43, 44, 45 and 46, and the bearing portions 431, 441, 451 and 461 respectively are provided with through holes 432, 442, 452 and 462 for insert of shaft portions 72c, 72c, 74c and 74c in a side of the connecting portion 7 to be described later. The through holes 432, 442, 452 and 462 are provided to penetrate through the bearing portions 431, 441, 451 and 461 in the thickness direction, and are positioned on a rotary shaft X 1 of the knob 5 (refer to Fig. 3).

[0025] As shown in Fig. 2C, the partition wall 47 is provided between the wall portion 43 and the wall portion 45 in the width direction of the cover 3, and the partition wall 48 is provided between the wall portion 44 and the wall portion 46 in the width direction of the cover 3, and the partition walls 47 and 48 are respectively lower in height than the wall portions 43, 44, 45 and 46. The partition walls 47 and 48 extend in parallel to the wall portions 43, 44, 45 and 46, and both ends thereof in the longitudinal direction are connected respectively to the wall portions 41 and 42.

[0026] In a plan view, a space S1 is provided between the partition wall 47 and the wall portion 45, and a space S1 is provided between the partition wall 48 and the wall portion 46, and the spaces S1 and S1 respectively accommodate click mechanisms to be described later. A space S2 is provided between the partition wall 47 and the wall portion 43, and a space S2 is provided between the partition wall 48 and the wall portion 44, and the spaces S2 and S2 each accommodate a cam 9 (9A and 9B) to be described later.

[0027] In a plan view, a spring accommodating portion 401 is opened to a central part in the longitudinal direction of the cover 3 in each of the spaces S1 and S1. As shown in Fig. 6, the spring accommodating portion 401 has a bottomed cylindrical shape, and is formed to project from a bottom wall portion 402 of the space S1 to the downside toward the polar board 2.

[0028] The spring accommodating portion 401 has a length L shorter than an axial length of a spring Sp, and a top end side of the spring Sp that is accommodated in the spring accommodating portion 401 projects above closer to the knob 5 than the bottom wall portion 402 formed in an arc shape in a plan view.

[0029] As shown in Fig. 2C, guide pieces 454 and 474 are provided on the respective opposing faces of the wall

portion 45 and the partition wall 47 that define the space S1 in such a manner as to surround an opening of the spring accommodating portions 401. In addition, guide pieces 464 and 484 are provided on the respective opposing faces of the wall portion 46 and the partition wall 48 that define the space S1 in such a manner as to surround an opening of the spring accommodating portions 401. The guide pieces 454, 464, 474 and 484 are linearly provided in parallel to a straight line Ln (refer to Fig. 6) that passes through the rotary shaft X1 of the knob 5 and extends in a direction perpendicular to the print substrate 22, and the top end sides of the springs Sp projecting within the spaces S1 are configured not to be shifted from the straight line Ln by the guide pieces 454, 464, 474 and 484.

[0030] The spring Sp that is accommodated in the spring accommodating portion 401 presses a ball B retained at its front end on a click groove 742a on the straight line Ln, and in the present embodiment, the ball B urged by the spring Sp, and the click groove 742a constitute the click mechanism.

[0031] The switch device 1 is configured such that the click mechanism gives a click feeling to an operator at the time of rotating the knob 5 around the rotary shaft X1. Further, when an operation force acting on the knob 5 (an operation portion 61a) is lost, the ball B is pressed in the depth side of the click groove 742a (upper side in Fig. 6) by the urging force of the spring Sp to return the knob 5 back to the reference position shown in Fig. 6.

[0032] As shown in Fig. 2C and Fig. 5, in each of the spaces S2 and S2, a rectangular opening 403a is formed to penetrate through the bottom wall portion 403 in the thickness direction to be in a position closer to the wall portion 41 in the longitudinal direction of the cover 3 in a plan view. Columnar shaft portions 404 and 404 are positioned in each of the openings 403a and 403a at a substantially central part in the longitudinal direction, and the shaft portions 404 and 404 are arranged to oppose to each other in each of the openings 403a and 403a to be spaced therebetween. The shaft portions 404 and 404 extend along a shaft line (rotary shaft X2 of the cam 9) in parallel to the rotary shaft X1 of the knob 5 from the lower part of the wall portions 43 and 44, and the partition walls 47 and 48 in a side of the polar board 2, and the cam 9 (9A and 9B) to be described later is rotatably supported by the shaft portions 404 and 404.

[0033] Hereinafter, an explanation will be made of the configuration of the cam 9 (9A and 9B). In the present embodiment, the cam 9B for switching on the switch element 23 and the cam 9A for switching on the switch element 24 are prepared. Here, since the cam 9A and the cam 9B are formed in the same shape, the cam 9A will be explained in the following explanation, and the other cam 9B will be explained as needed. In addition, in a case where the cam 9A and the cam 9B are not particularly distinct, each of the cams is indicated simply as a cam 9.

[0034] As shown in Fig. 5, the cam 9A includes a con-

necting portion 91 having an insert hole 91a and an operated portion 92 formed in a substantial fan shape in a side view, and the connecting portion 91 projects down-side in a side of the polar board 2 from the center of the operated portion 92 in the width direction.

[0035] The cam 9A and 9B is rotatably supported by the shaft portion 404 in a side of the cover 3 that is inserted in the insert hole 91a in a direction where the operated portion 92 is positioned upward in a side of the knob 5 (refer to Fig. 5 and Fig. 7). A lower face of the operated portion 92 in a side of the print substrate 22 is configured with pressing portions 92a and 92b for pressing the operated portions 23a and 24a of the switch elements 23 and 24. The pressing portions 92a and 92b are positioned to be symmetrical around a straight line Lo that passes through the rotary shaft X2 of the cam 9A and is perpendicular to the print substrate 22 in a state where the cam 9A is arranged in a reference position shown in Fig. 5.

[0036] In the present embodiment, the cam 9A is provided in a state where the pressing portion 92b of one side makes contact with the operated portion 24a of the switch element 24, and the cam 9B is provided in a state where the pressing portion 92a of the other side makes contact with the operated portion 23a of the switch element 23 (refer to Fig. 5 and Fig. 7).

[0037] As shown in Fig. 5, the operated portion 92 is provided with an engagement groove 93 to which an operation portion 733 (engagement portion 733a) extending from the knob 5 is engaged, and the engagement groove 93 extends linearly in a range to the vicinity of the connecting portion 91 from the arc-shaped outer periphery of the operated portion 92 along a straight line Lm passing through the rotary shaft X2 of the cam 9A. Both sides of the engagement groove 93 on the outer periphery of the operated portion 92 are cut away for easy engagement of the engagement portion 733a to the engagement groove 93, and an opening width of the engagement groove 93 becomes wider toward the outer periphery of the operated portion 92.

[0038] In the present embodiment, the engagement portion 733a rotates around the rotary shaft X1 in association with an operation of the knob 5, and the cam 9 (9A and 9B) rotatable around the rotary shaft X2 is made to rotate in one direction determined corresponding to an operation direction of the knob 5 by the engagement portion 733a rotating around the rotary shaft X1.

[0039] As shown in Fig. 1, the knob 5 that is rotatably supported by the support portion 4 of the cover 3 includes a head portion 6 one side of which is formed as an operation portion 61a in the longitudinal direction, and the connecting portion 7 that is mounted to a lower face of the head portion 6 and causes the knob 5 to be rotatably supported by the support portion 4.

[0040] The head portion 6 has a peripheral wall portion 62 extending downward in a side of the cover 3 from the peripheral edge of a top wall portion 61, and in each side of the head portion 6 in the width direction are formed engagement holes 62a for engagement of engagement

projections 72a of the connecting portion 7, and a bearing hole 62b for insert of a shaft portion 72b extending from both sides of the connecting portion 7. A plurality of the engagement holes 62a are provided to be spaced from each other in the longitudinal direction of the head portion 6, and the bearing hole 62b is provided in a side of the base portion 61b to which the rotary shaft X1 of the knob 5 is set.

[0041] As shown in Fig. 4, the connecting portion 7 has the rectangular base portion 71 in a plan view, and side wall portions 72 extending downward in a side of the polar board 2 are provided in both sides of the base portion 71 in the width direction. The side wall portion 72 is provided across an entire length of the base portion 71 in the longitudinal direction, and the engagement projections 72a and the shaft portion 72b are provided on an outer side face of the side wall portion 72. The connecting portion 7 is incorporated in the head portion 6 by engaging the engagement projection 72a and the shaft portion 72b to the engagement hole 62a and the bearing hole 62b in a side of the head portion 6. When the operation portion 61a is operated, the head portion 6 and the connecting portion 7 rotate integrally around the rotary shaft X1 of the knob 5.

[0042] The columnar shaft portion 72c is provided on an inner side face of the side wall portion 72 in a position at the opposite side to the shaft portion 72b, and the shaft portion 72c projects inside along the rotary shaft X1 of the knob 5. The shaft portions 72c are, at the time the knob 5 is mounted to the support portion 4, inserted into through holes 432 and 442 of the shaft portions 431 and 441 of the support portion 4 (refer to Fig. 3).

[0043] As shown in Fig. 3, lever portions 721 extending downward in a side of the print substrate 22 outside of the side wall portion 72 are connected to a lower face of the side wall portion 72 in a side of the cover 3. The lever portion 721 is, at the time the knob 5 is incorporated in the cover 3, inserted between restriction walls 36 and 37 in a side of the cover 3 (refer to Fig. 1). In the present embodiment, the lever portion 721 rotates around the rotary shaft X1 in association with an operation of the knob 5, and when the lever portion 721 makes contact with one of the restriction walls 36 and 37 determined corresponding to an operation direction of the knob 5, at that point rotation of the knob 5 is restricted.

[0044] As shown in Fig. 3 and Fig. 4, the operation portion 73 (73A and 73B) and the support wall portion 74 (74A and 74B) are provided inside the side wall portion 72 to be spaced from each other in the width direction of the base portion 71. The operation portion 73 (73A and 73B) and the support wall portion 74 (74A and 74B) extend downward in a side of the cover 3 from the base portion 71. The operation portions 73 (73A and 73B) and the support wall portions 74 (74A and 74B) are arranged to be symmetrical around a center line M in the width direction of the base portion 71, and the operation portion 73A and the support portion 74A are positioned in a side of the cam 9A described above, and the operation portion

73B and the support portion 74B are positioned in a side of the cam 9B described above. It should be noted that in a case where the operation portions 73A and 73B, and the support wall portions 74A and 74B respectively are not particularly distinct, they respectively are simply indicated as the operation portion 73, and the support wall portion 74.

[0045] As shown in Fig. 4B, the operation portion 73 (73A and 73B) and the support wall portion 74 (74A and 74B) are respectively provided in parallel to the side wall portion 72, longitudinal directional end portions of which are connected to each other by ribs 75 for reinforcement. Here, since the operation portions 73A and 73B, and the support wall portions 74A and 74B respectively have the same configurations, the configuration of the operation portion 73A as one thereof and the configuration of the support wall portion 74A as one thereof will be specifically explained.

[0046] As shown in Fig. 5, the operation portion 73A includes a rectangular base end portion 731 extending downward in a side of the cover 3 from the base portion 71, a semicircle portion 732 projecting downward in a side of the cover 3 from a substantially central part of the base end portion 731 in the longitudinal direction, and the operation portion 733 extending downward in a side of the print substrate 22 from the semicircle 732. The operation portion 733 extends along the straight line Lm connecting the rotary shaft X1 of the knob 5 and the rotary shaft X2 of the cam 9A, and the substantially circular engagement portion 733a that is provided at a front end thereof is engaged to the engagement groove 93 of the cam 9A on the straight line Lm.

[0047] As shown in Fig. 6, the support wall portion 74A includes a rectangular base end portion 741 extending downward in a side of the cover 3 from the base portion 71, and a rectangular portion 742 projecting downward in a side of the cover 3 from a substantially central part of the base end portion 741 in the longitudinal direction, and the click mechanism 742a that is recessed upward in a side of the knob 5 is formed in the longitudinal center at a lower end of the rectangular portion 742 in a side of the cover 3. The click mechanism 742a is positioned on the straight line Ln that passes through the rotary shaft X1 of the knob 5 and is perpendicular to the polar board 2 in a state where the knob 5 is arranged in the reference position, and the ball B urged by the spring Sp makes contact with the click groove 742a downward in a side of the polar board 2.

[0048] As shown in Figs. 4A and 4B, in the base portion 71 the support wall portions 74A and 74B are provided to be symmetrical around the center line M in the width direction of the base portion 71, and the columnar shaft portions 74c are provided on the respective opposing faces of the support wall portions 74A and 74B. The shaft portion 74c, as similar to the shaft portion 72c of the above-mentioned side wall portion 72, extends to a side of the center line M of the base portion 71 on the rotary shaft X1 of the knob 5.

[0049] In the present embodiment, the shaft portions 74c of the support wall portions 74 (74A and 74B), and the shaft portions 72c of the side wall portions 72 are respectively inserted into through holes 452 and 462 of bearing portions 451 and 461 of the support portion 4 and into through holes 432 and 442 of bearing portions 431 and 441, thus rotatably supporting the knob 5 by the support portion 4 (refer to Fig. 3).

[0050] Hereinafter, an operation of the switch device 1 having the above configuration will be explained. Figs. 7A and 7B are diagrams explaining the operation of the switch device 1, wherein Fig. 7A is a diagram explaining a case of operating the operation portion 61a of the knob 5 in a pulling-up direction (refer to an arrow A in the figure), and Fig. 7B is a diagram explaining a case of operating the operation portion 61a of the knob 5 in a pushing-down direction (refer to an arrow B in the figure). It should be noted that Fig. 7A is equivalent to A-A section in Fig. 3, and Fig. 7B is equivalent to C-C section in Fig. 3.

[0051] In a state where the operation force does not exert on the knob 5, the knob 5 is arranged in the reference position shown in Fig. 6 by the click mechanism that causes the ball B to be engaged to the click groove 742a by the urging force of the spring Sp. In this state, the cam 9 (9A and 9B), to which the operation portion 73 (73A and 73B) extending from a side of the knob 5 is engaged, is arranged in the reference position shown in Fig. 5. In this reference position, the pressing portions 92a and 92b of the cam 9 (9A and 9B) are arranged to be symmetrical around the straight line Lo that passes through the rotary shaft X2 of the cam 9 and extends in a direction perpendicular to the print substrate 22 (refer to Fig. 5), and the cam 9A places the pressing portion 92b on the operated portion 24a of the switch element 24, and the cam 9B places the pressing portion 92a on the operated portion 23a of the switch element 23 (refer also to Fig. 7).

[0052] When a side of the operation portion 61a of the knob 5 is operated in a pulling-up direction (direction of an arrow A in Fig. 5 and Fig. 7) from this state, the engagement portion 733a of the operation portion 73 (73A and 73B) extending from the knob 5 rotates in a clockwise direction in the figure in the circumferential direction around the rotary shaft X1 of the knob 5 to rotate the cam 9 (9A and 9B) in the counter clockwise direction in the figure in the circumferential direction around the rotary shaft X2. Thereby the pressing portion 92b of the cam 9A pushes down the operated portion 24a of the switch element 24 downward in a side of the print substrate 22 to switch on the switch element 24.

[0053] In addition, When the side of the operation portion 61a of the knob 5 is operated in a pushing-in direction (direction of an arrow B in Fig. 5 and Fig. 7) from a state shown in Fig. 5, the engagement portion 733a of the operation portion 73 (73A and 73B) extending from the knob 5 rotates in a counter clockwise direction in the figure in the circumferential direction around the rotary shaft X1 of the knob 5 to rotate the cam 9 (9A and 9B) in the

clockwise direction in the figure in the circumferential direction around the rotary shaft X2. Thereby the pressing portion 92a of the cam 9 pushes down the operated portion 23a of the switch element 23 downward in a side of the print substrate 22 to switch on the switch element 23.

[0054] Here, as shown in Fig. 5, the cam 9 (9A and 9B) is configured such that the rotary shaft X2 is set to the center of the cam 9 (9A and 9B) in the width direction, and the pressing portions 92a and 92b of the cam 9 (9A and 9B) are symmetrical around the straight line Lo that passes through the rotary shaft X2 and is perpendicular to the print substrate 22. Therefore a rotational angle θ of the cam 9 (9A and 9B) at the time of switching on the switch element 24 is the same as a rotational angle θ of the cam 9 (9A and 9B) at the time of switching on the switch element 23 by arranging the switch elements 23 and 24 to be symmetrical around the straight line Lo.

[0055] Then, a rotational angle $\theta 1$ of the knob 5 at the time of rotating the cam 9 (9A and 9B) by the engagement portion 733a of the operation portion 73 (73A and 73B) is also the same in both of a case of switching on the switch element 24 and of a case of switching on the switch element 23. Therefore even if the rotary shaft of the knob 5 is set to a position closer to the opposite side to the operation portion 61a in the longitudinal direction of the knob 5, the switch elements 23 and 24 are not directly switched on by a member rotating integrally with the knob 5, and the cam 9 (9A and 9B) is rotated by the engagement portion 733a of the operation portion 73 (73A and 73B) rotating integrally with the knob 5, and the switch elements 23 and 24 are switched on by the rotated cam 9 (9A and 9B). Therefore the operation amount of the knob 5 can be the same in both of a case of switching on the switch element 24 and of a case of switching on the switch element 23.

[0056] As described above, according to the present embodiment, the switch device 1 comprises:

the knob 5 that is supported to be rotatable around the rotary shaft X1 in the support portion 4 of the cover 3;

the cam 9 (9A and 9B) that is supported to be rotatable around the rotary shaft X2 in the cover 3 and is rotated from the reference position (refer to Fig. 5) in the predetermined direction determined corresponding to the rotational direction of the knob 5 by the operation portion 73 (73A and 73B) extending from the knob 5;

the switch element 24 that, when the cam 9 (9A and 9B) is rotated in one direction around the rotary shaft X2, is switched on by the pressing portion 92b in one side of the cam 9A; and

the switch element 23 that, when the cam 9 (9A and 9B) is rotated in the other direction around the rotary shaft X2, is switched on by the pressing portion 92a in the other side of the cam 9B, wherein as viewed in the shaft direction of the rotary shaft X2 of the cam 9 (9A and 9B), the switch element 23 and

the switch element 24, and the pressing portion 92b in the one side of the cam 9 (9A and 9B) and the pressing portion 92a in the other side are respectively arranged to be symmetrical around the rotary shaft X2.

[0057] According to this configuration, the rotational angle θ (refer to Fig. 7A) of the cam 9 (9A and 9B) from the reference position at the time of switching on the switch element 24 is equal to the rotational angle θ (refer to Fig. 7B) of the cam 9 (9A and 9B) from the reference position at the time of switching on the switch element 23. Therefore the rotational angle θ_1 (refer to Figs. 7A and 7B) of the knob 5 at the time of rotating the cam 9 (9A and 9B) by the operation portion 73 (73A and 73B) also becomes the same in both of a case of switching on the switch element 24 and of a case of switching on the switch element 23. Therefore, also when the rotary shaft X1 of the knob 5 is set to the one side of the knob 5 in the longitudinal direction (side of the base portion 61b positioned at the opposite side to the operation portion 61a), in any of a case of switching on the switch element 24 and of a case of switching on the switch element 23, the rotational angle θ_1 of the knob 5 around the rotary shaft X1 becomes the same. Accordingly, the operation amount of the knob 5 can be controlled not to differ depending on the operation direction of the knob 5.

[0058] Particularly the switch elements 23 and 24 are not directly switched on by the operation portion 73 (73A and 73B) rotating around the rotary shaft X1 integrally with the knob 5, and the cam 9 (9A and 9B) is rotated by the engagement portion 733a of the operation portion 73 (73A and 73B), and the rotated cam 9 (9A and 9B) causes the switch elements 23 and 24 to switch on. Therefore even if the rotary shaft X1 of the knob 5 is set to the opposite side (side of the base portion 61b) to the operation portion 61a in the longitudinal direction of the knob 5, the stroke amount of each of the switch elements 24 and 23 does not become insufficient.

[0059] Further, as viewed in the shaft direction of the rotary shaft X2 of the cam 9 (9A and 9B), the switch element 23 and the switch element 24, and the pressing portion 92b of the cam 9 (9A and 9B) at one side thereof and the pressing portion 92a thereof at the other side are respectively arranged to be symmetrical around the rotary shaft X2. Therefore the pushing-in amount (the stroke amount) of the operated portion 24a or 23a of the switch element 24 or 23 by the pressing portion 92b or 92a of the cam 9 (9A and 9B) can be equal in any of a case of operating the knob 5 in the pulling-up direction (refer to an arrow A in Fig. 5) from the reference position shown in Fig. 5 and of a case of operating the knob 5 in the pushing-down direction (refer to an arrow B in the figure).

[0060] The knob 5 is configured such that the operation portion 61a that is operated at the time of rotating the knob 5 is provided in one side of the knob 5 in the longitudinal direction, and the rotary shaft X1 of the knob 5 is

set closer to the base portion 61b of the knob 5 at the opposite side to the operation portion 61a thereof in the longitudinal direction.

[0061] According to this configuration, in a case where the operation force is added to a position (side of the base portion 61b) of the knob 5 away from the operation portion 61a, it is possible to certainly prevent the knob 5 from rotating. Therefore when the knob 5 is operated in the pulling-up direction (refer to an arrow A in Fig. 5) from the reference position shown in Fig. 5, in a case where an external device (for example, a brake device) to which the switch device 1 is connected is switched on, it is possible to certainly prevent the external device from switching on without intention when the opposite side of the knob 5 to the operation portion 61a is in error pushed or the like.

[0062] The rotary shaft X2 of the cam 9 (9A and 9B) is configured to be set in parallel to the rotary shaft X1 of the knob 5, and in a position that is offset to a side of the operation portion 61a from the rotary shaft X2 in the longitudinal direction of the knob 5.

[0063] According to this configuration, it is possible to secure the space for providing the cam 9 (9A and 9B) downward of the knob 5 in a side of the polar board 2 by using the longitudinal width of the knob 5. Therefore an increase in size of the switch device 1 in the longitudinal direction of the knob 5 due to provision of the cam 9 (9A and 9B) can appropriately be prevented.

[0064] Here, the engagement portion 733a of the operation portion 73 is, as viewed in an axial direction of the rotary shaft X1 of the knob 5, engaged to the engagement groove 93 of the cam 9 (9A and 9B) on the straight line Lm connecting the rotary shaft X1 of the knob 5 and the rotary shaft X2 of the cam 9 (9A and 9B). As a result, in any of a case of switching on the switch element 24 and of a case of switching on the switch element 23, the rotational angle θ_1 of the knob 5 around the rotary shaft X1 and the rotational angle θ of the cam 9 (9A and 9B) around the rotary shaft X2 respectively can certainly be made to the same.

[0065] The cam 9 is configured with the cam 9A of switching on the switch element 24 and the cam 9B of switching on the switch element 23, and the cam 9A and the cam 9B are provided to be spaced in an axial direction of the rotary shaft X2 in common to the cam 9A and the cam 9B. The operation portion 73 in a side of the knob 5 is configured with the operation portion 73A for rotating the cam 9A and the operation portion 73B for rotating the cam 9B, wherein the operation portions 73A and 73B are provided to be spaced in an axial direction of the rotary shaft X1 of the knob 5. The cam 9A and the cam 9B, and the operation portion 73A and the operation portion 73B are respectively provided to be symmetrical around the center line M in the width direction of the knob 5.

[0066] According to this configuration, the space can be secured in the central part of the knob 5 in the width direction, for example, for guiding irradiation light from a light emitting element provided in the print substrate 22

to the top wall portion 61. Further, when a plurality of the operation portions 73 (73A and 73B) and a plurality of the cams 9 (9A and 9B) are provided, since the operation force acting on them at the time of operating the knob 5 can be dispersed, an improvement on durability of the switch device 1 will be realized.

[0067] It should be noted that in the above embodiment, there is exemplified a case of operating the switch elements 23 and 24 respectively by the different cams 9B and 9A, but the configuration that two switch elements are switched on by a single cam may be adopted. In this case, the two switch elements may be arranged to be symmetrical around the rotary shaft X2 such that, when the cam 9 rotates in one direction around the rotary shaft X2, the switch element at one side is switched on by the pressing portion 92a at one side, and when the cam 9 rotates in the other direction, the switch element at the other side is switched on by the pressing portion 92b at the other side.

Claims

1. A switch device (1) comprising:

a knob (5) that is rotatable around a first shaft (X1);

a cam (9A,B) that is rotatable around a second shaft (X2) from a reference position in a predetermined direction determined by a rotational direction of the knob (5) by an operation element (73A,B) extending from the knob (5);

a first switch element (23) that, when the cam (9A,B) is rotated in one direction around the second shaft (X2), is switched on by a first pressing portion (92a) at one side of the cam (9A,B) engaging an actuation portion (23a) of the switch element (23); and

a second switch element (24) that, when the cam is rotated in the other direction around the second shaft, is switched on by a second pressing portion (92b) at the other side of the cam engaging an actuation portion (24a) of the switch element (24); wherein

as viewed in a shaft direction of the rotary shaft (X2) of the cam (9A,B): (a), the first and second switch elements (23,24), and (b) the first and second pressing portions (92a,b) are respectively arranged to be symmetrical around the second shaft (X2).

2. A switch device according to claim 1, wherein the knob (5) is provided with an operation portion (61a), to which force is applied in use, said operation portion (61a) being at one side of the knob (5) in the longitudinal direction, the operation portion being operated to effect rotation of the knob (5), and the first shaft (X1) of the knob is set closer to the other side

in the longitudinal direction.

3. A switch device according to claim 1 or 2, wherein the second shaft (X2) is set in parallel to the first shaft (X1), and is set in a position offset to a side of the operation portion (61a) from the first shaft (X1) in the longitudinal direction of the knob (5).

4. A switch device according to claim 1 or 2, wherein the cam includes a first cam (9B) for switching on the first switch element (23) and a second cam (9A) for switching on the second switch element (24), wherein the first cam (9B) and the second cam (9A) are spaced from each other in an axial direction of the second shaft (X2), the operation element includes a first operation element (73B) for rotating the first cam (9B) and a second operation element (73A) for rotating the second cam (9A), wherein the first and second operation element (73A,B) are spaced from each other in an axial direction of the first shaft (X1), and

(a) the first and second cams (9A,B) and (b) the first and second operation elements (73A,B) are respectively provided to be symmetrical around a center line of the knob (5) in the width direction.

Fig.1

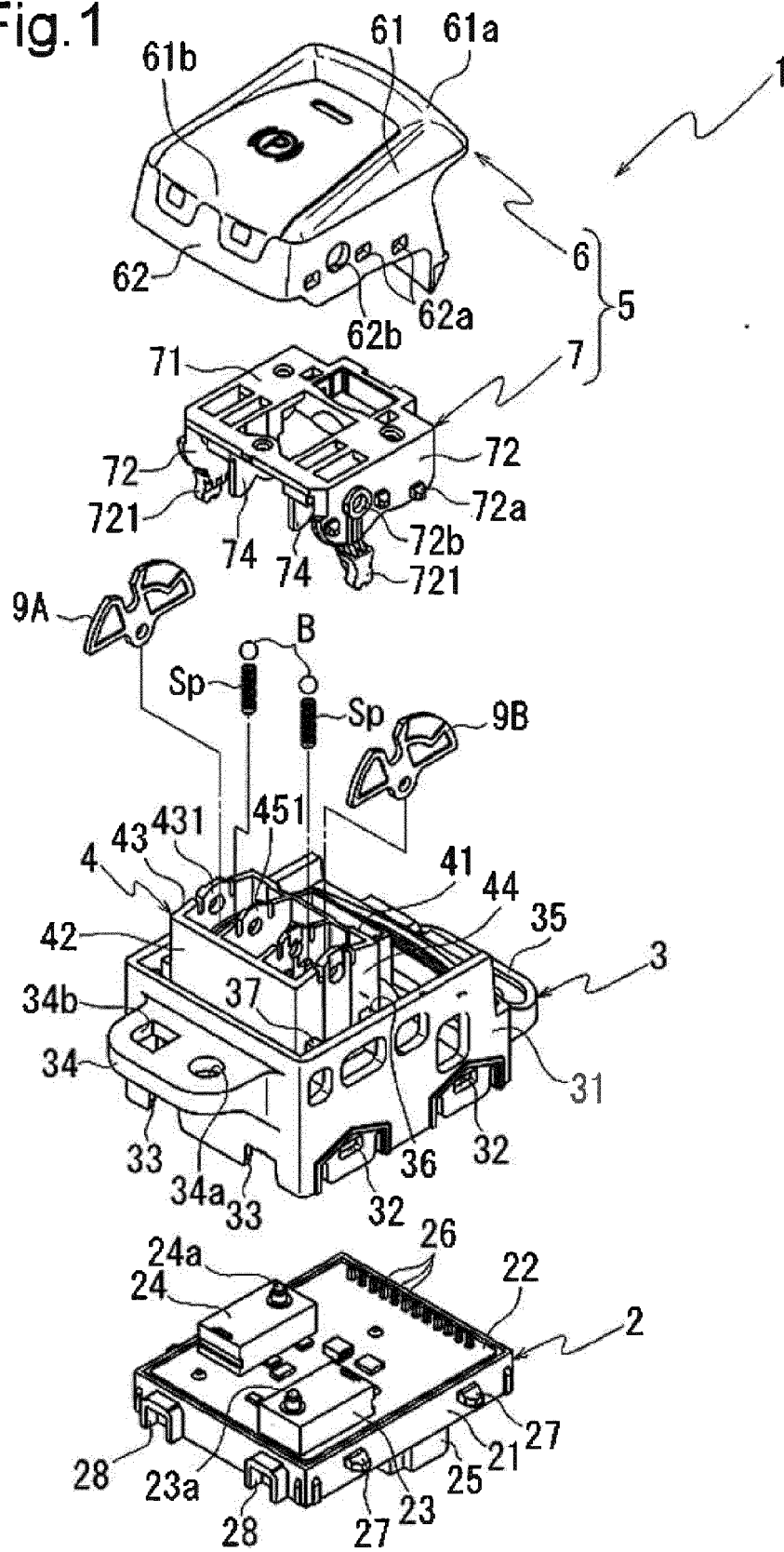


Fig.2

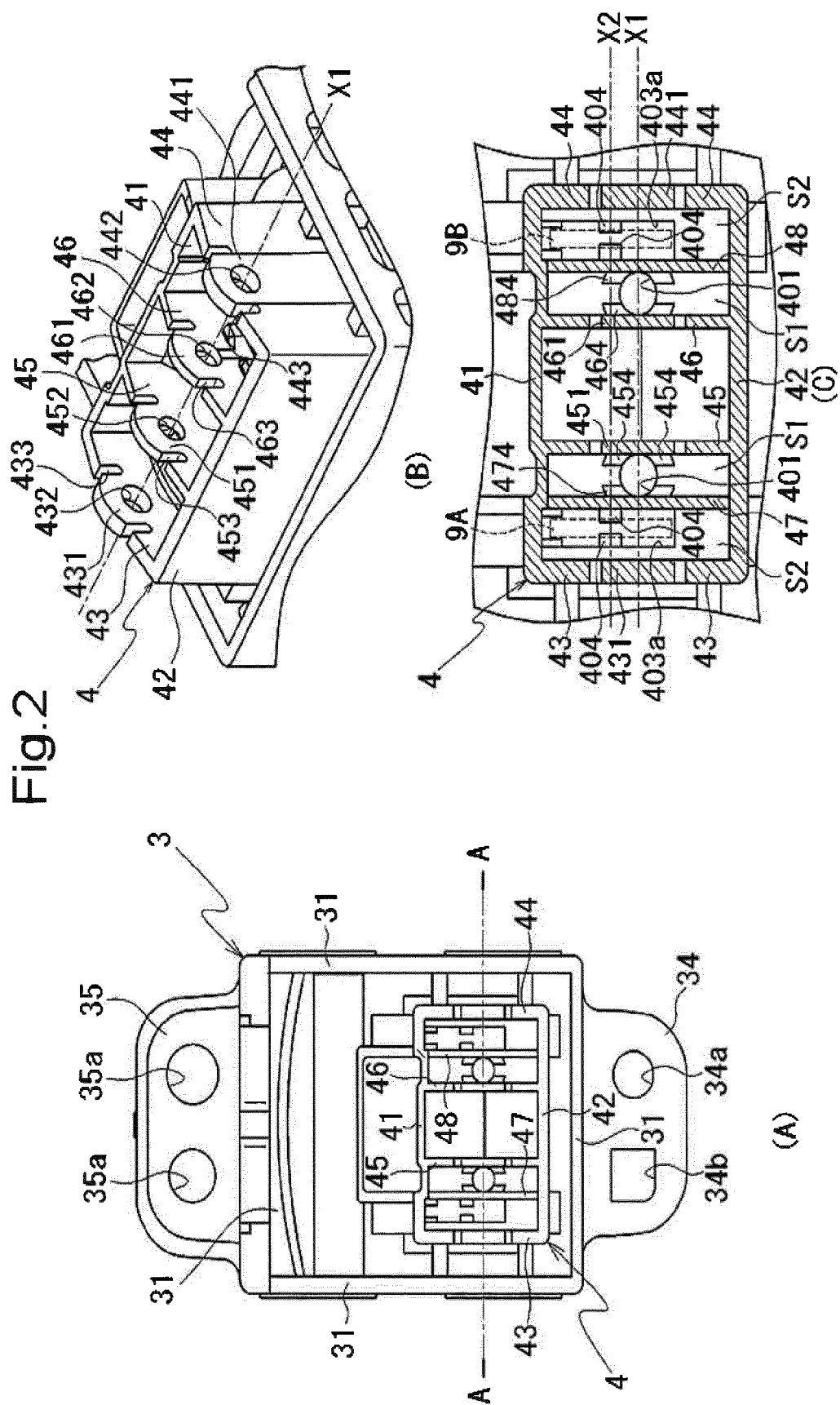


Fig.3

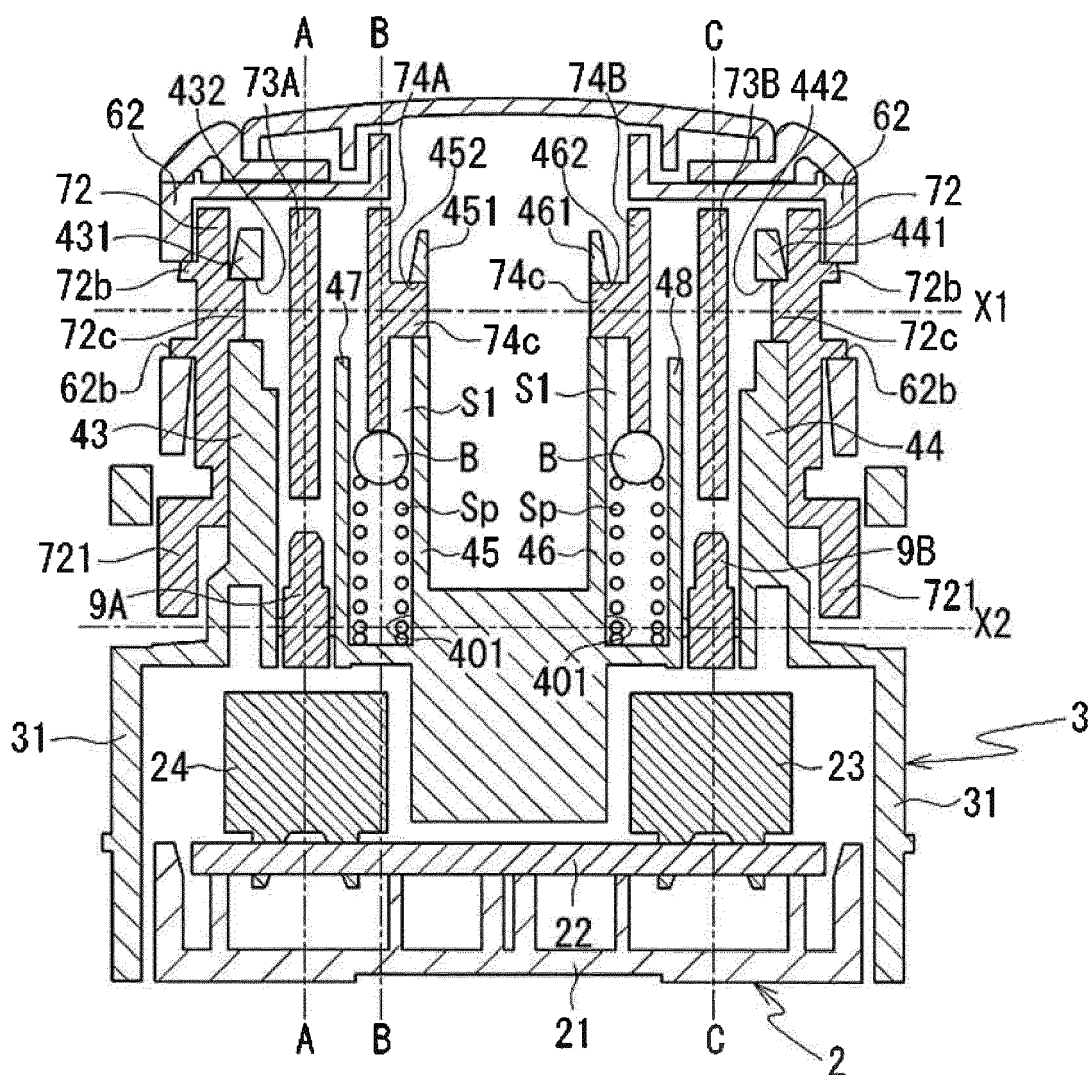


Fig.4

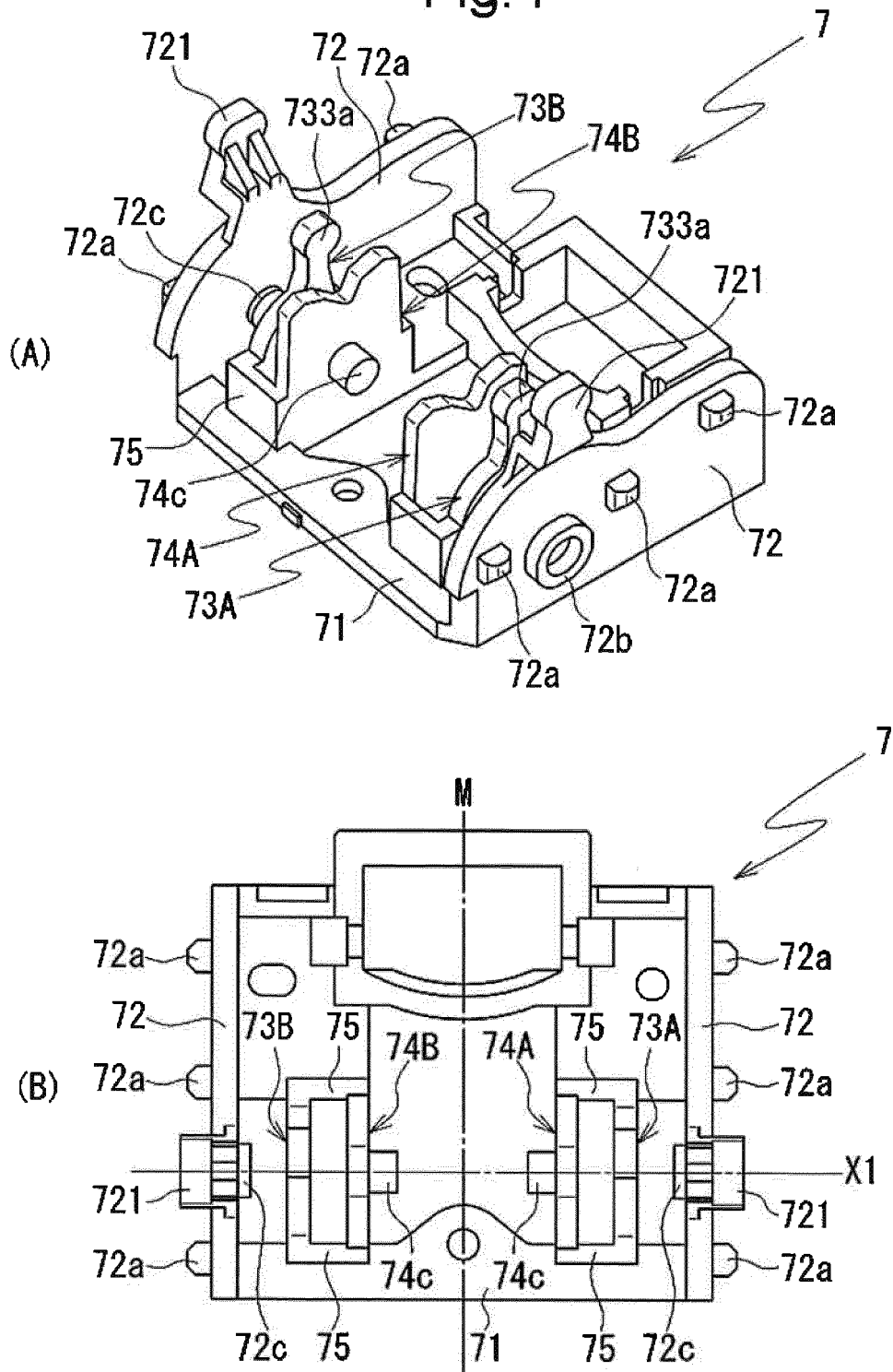


Fig.5

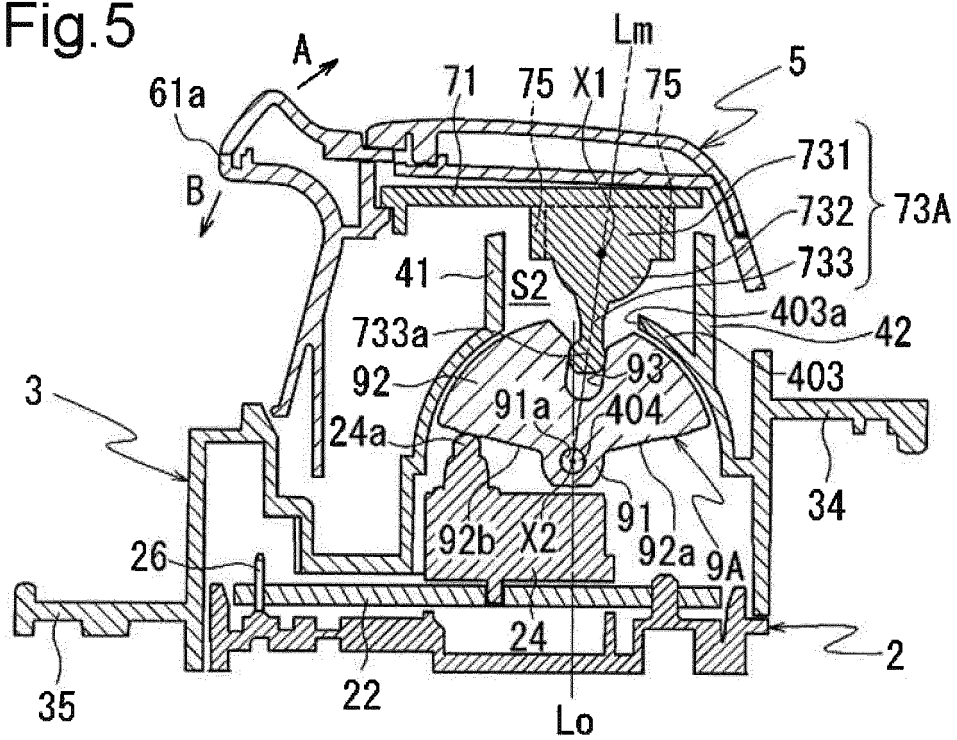


Fig.6

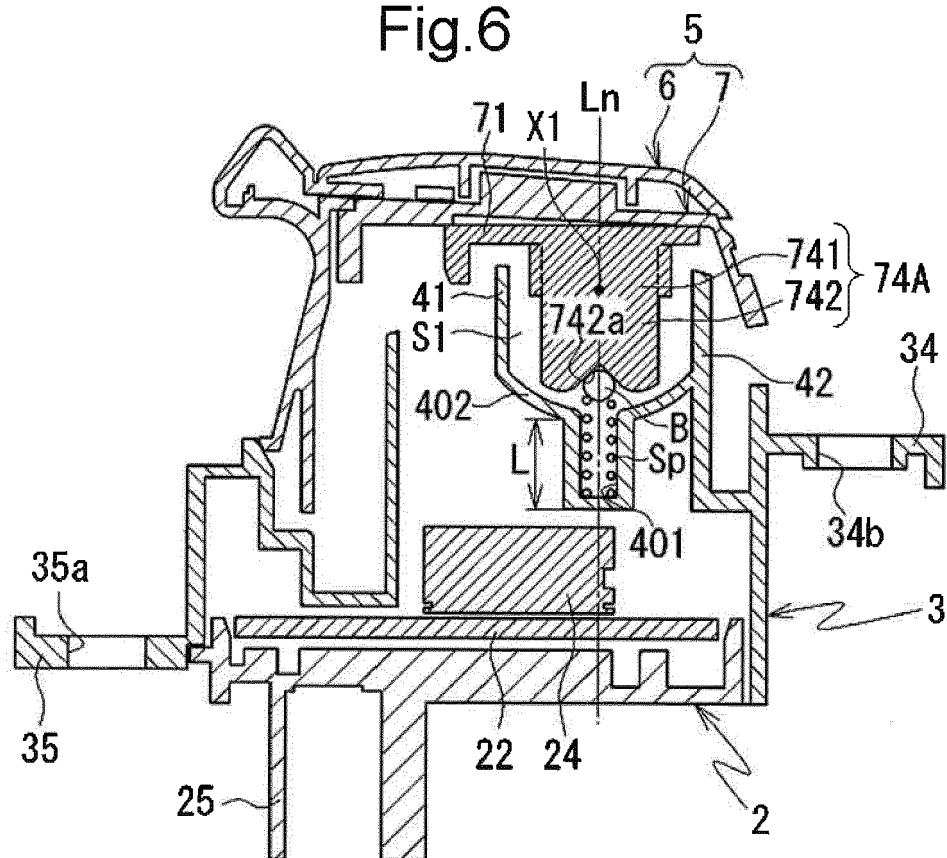


Fig.7

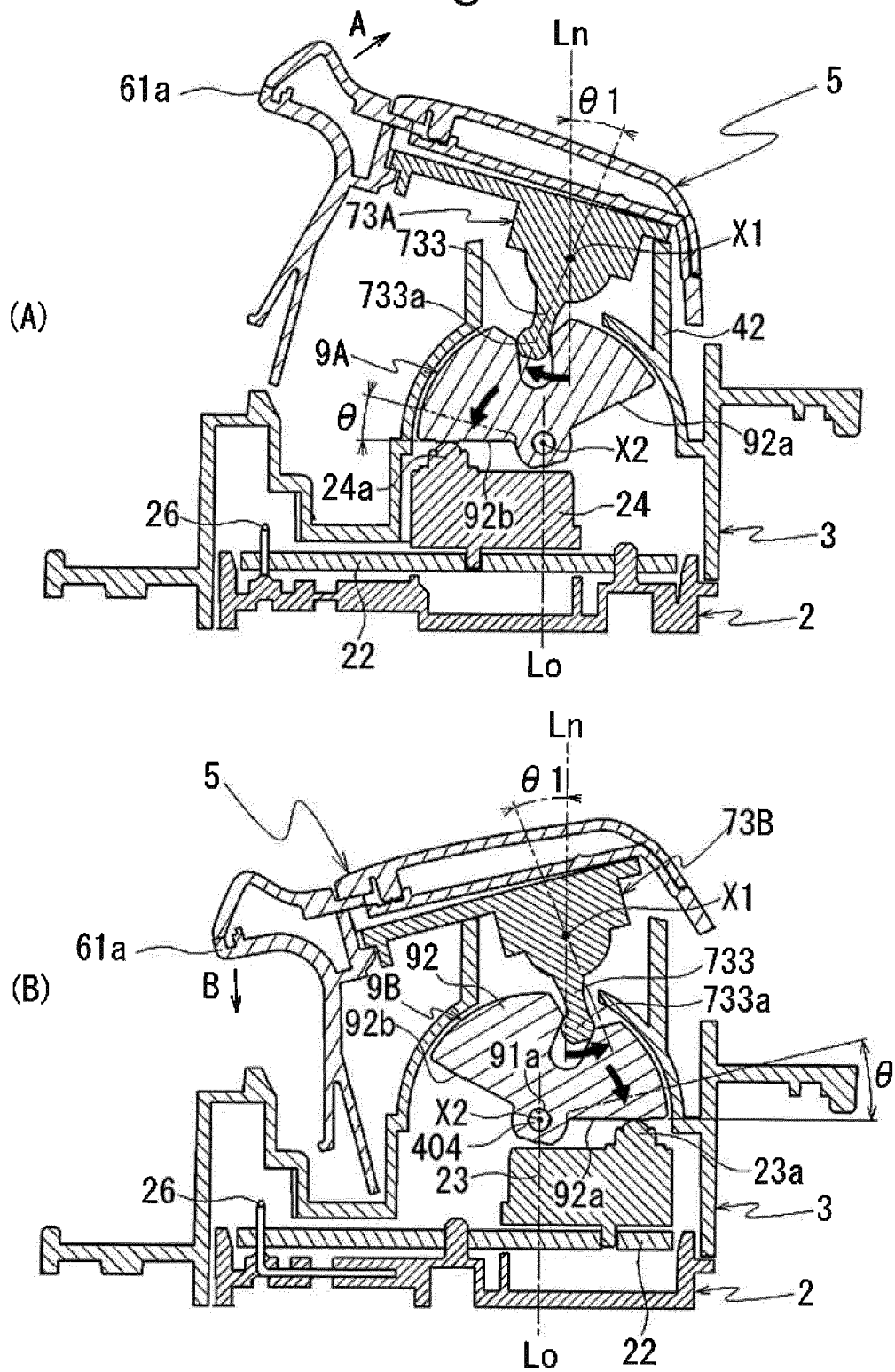
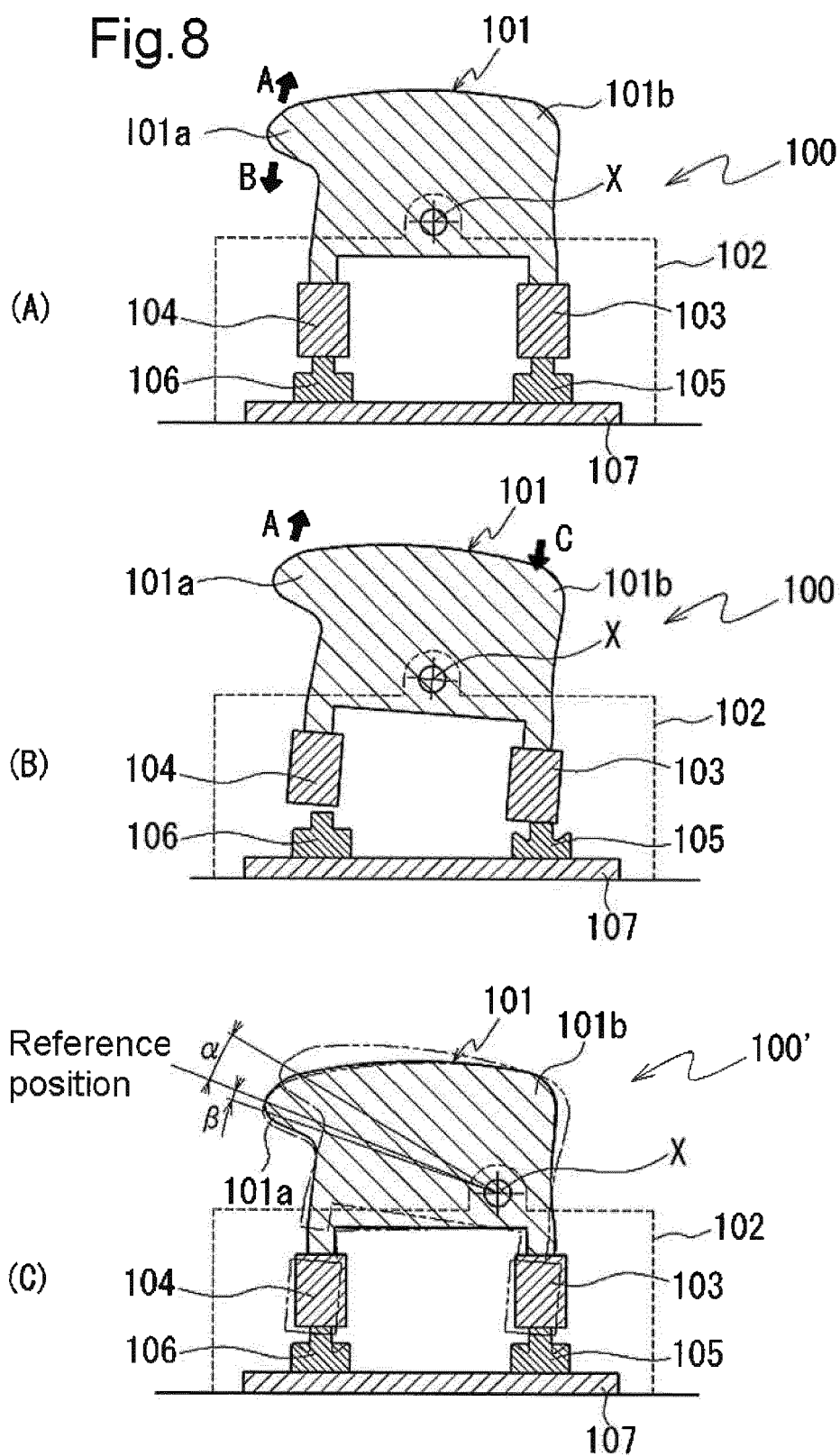


Fig.8





EUROPEAN SEARCH REPORT

Application Number
EP 13 19 0843

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 492 940 A1 (ALPS ELECTRIC CO LTD [JP]) 29 August 2012 (2012-08-29)	1	INV. H01H23/16
Y	* paragraphs [0016] - [0018], [0022] - [0025], [0029]; figure 1 *	2-4	H01H23/00 H01H23/30
Y	EP 2 468 590 A1 (BITRON SPA [IT]) 27 June 2012 (2012-06-27) * paragraphs [0013] - [0017]; figures 1, 2 * * paragraph [0001] *	2	ADD. H01H21/22
Y	EP 1 288 985 A2 (NILES PARTS CO LTD [JP]) 5 March 2003 (2003-03-05) * paragraphs [0029] - [0030], [0045], [0084]; figure 4 *	3	
Y	EP 2 498 269 A1 (BITRON SPA [IT]) 12 September 2012 (2012-09-12)	4	
A	* paragraphs [0032] - [0033]; figure 1 * * paragraphs [0020] - [0022]; figure 2 *	1,2	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 February 2014	Examiner Bräckelmann, Gregor
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ON EUROPEAN PATENT APPLICATION NO.**

EP 13 19 0843

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27-02-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2492940 A1	29-08-2012	EP 2492940 A1	29-08-2012
		JP 2012178247 A	13-09-2012
		US 2012217144 A1	30-08-2012
EP 2468590 A1	27-06-2012	EP 2468590 A1	27-06-2012
		ES 2439076 T3	21-01-2014
EP 1288985 A2	05-03-2003	EP 1288985 A2	05-03-2003
		EP 1843372 A2	10-10-2007
		JP 4583675 B2	17-11-2010
		JP 2003077370 A	14-03-2003
		US 2003042124 A1	06-03-2003
EP 2498269 A1	12-09-2012	BR 102012005115 A2	21-01-2014
		CN 102683083 A	19-09-2012
		EP 2498269 A1	12-09-2012

EPO FORM P0459

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006315468 A [0002] [0003]