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(54) **CONTROL DEVICE**

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(56) References cited:
EP-A2- 1 528 585
DE-B3-102004 022 068
DE-U1- 29 924 859
JP-A- 2000 315 431

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a control device that includes an operating portion that protrudes from a reference surface.

2. Description of the Related Art

[0002] Japanese Patent Application Publication No. JP 2001-266704 A, Japanese Patent Application Publication No. JP 2001-189116 A, Japanese Patent Application Publication No. JP 2006-253063A, Japanese Patent Application Publication No. JP 2006-277045A, and Japanese Patent Application Publication No. JP 2008-273313A, for example, describe as related art a structure in which, in such a control device, an operating portion is able to irreversibly reduce a protrusion amount to equal to or less than a predetermined protrusion amount when a large load (i.e., a load in a direction that reduces the protrusion amount) is applied to the operating portion.

[0003] However, in a structure such as that described in the publications above, the operating portion irreversibly reduces the protrusion amount, so once the protrusion amount is reduced, the operating portion is unable to operate thereafter, or the operability ends up deteriorating, which is problematic. A switch-interlocking type retractable knob that comprises a retractable knob which includes an operation knob and a retractable shaft for retracting the operation knob is furthermore disclosed by Japanese Patent Application Publication No. JP 2000-315431 A. The retractable knob is held in a thrusted position when the operation knob is pressed, and returns to an original position when the knob pressed again.

SUMMARY OF THE INVENTION

[0004] In view of the problem described above, one aspect of the invention provides a control device according to independent claims 1 and 3 that includes a base plate, an operating portion that protrudes from a reference surface located apart from the base plate, and an elastic body. In response to a load of equal to or greater than a predetermined load applied in a direction that reduces a protrusion amount, the operating portion moves more than a maximum stroke amount within an operating stroke, against a repulsion force of the elastic body in the direction in which the protrusion amount decreases. The operating portion is supported via the elastic body so as to return to an original protrusion amount by a restoring force of the elastic body when the load is removed.

[0005] According to the invention, a control device in which the protrusion amount of the protruding portion can be reduced, while the protruding portion is able to be restored to its original state after the protrusion amount is reduced, can be obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Features, advantages, and technical and industrial significance of this invention will be described in the following detailed description of example embodiments of the invention with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG 1 is a perspective view of an example of a control device according to one example embodiment of the invention, in an assembled state;
FIG. 2 is an exploded perspective view of the control device of this example embodiment;
FIGS. 3A, 3B, and 3C are perspective views of the exterior of the control device in each state (i.e., an unloaded state, a partially pushed in state, and a fully pushed in state);
FIGS. 4A, 4B, and 4C are perspective views of the main portions of the control device in each state (i.e., the unloaded state, the partially pushed in state, and the fully pushed in state);
FIGS. 5A, 5B, and 5C are perspective views of an encoder of the control device in each state (i.e., the unloaded state, the partially pushed in state, and the fully pushed in state);
FIGS. 6A, 6B, and 6C are perspective views of an internal mechanism of the control device in each state (i.e., the unloaded state, the partially pushed in state, and the fully pushed in state);
FIG. 7 is a graph of an example of an elastic characteristic of a spring of the control device;
FIG. 8 is a graph of another example of the elastic characteristic of the spring of the control device; and
FIG. 9 is a simplified sectional view of the main portions of a modified example of the example embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0007] Hereinafter, an example embodiment of the invention will be described with reference to the accompanying drawings. FIG. 1 is a view of an example of a control device 1 according to one example embodiment of the invention, in an assembled state. The control device 1 is provided in a position taking operability into account, in a vehicle cabin. The control device 1 of this example embodiment is typically preferably provided in a location where it may be struck by the body of an occupant when a collision or the like occurs. The control device 1 may be a device for operating appropriate on-board equipment.

[0008] In the example shown in the drawings, the control device 1 is embodied as a control knob and is incorporated into a front panel. In the example shown in the drawings, the control device 1 is a control device for adjusting the volume and the like of an on-board audio device.

[0009] The control device 1 may be only able to be rotated, only able to be pushed in (i.e., depressed), or able to be both rotated and pushed in. The control device 1 mainly described as an example hereinafter is able to be both rotated and pushed in. With the control device 1 of an on-board audio device, a rotating operation may be an operation for adjusting the volume of the on-board audio device, and a push-in operation may be an "enter" or "select" operation or an operation for turning the power on and off.

[0010] The control device 1 includes an operating portion 1a that protrudes out from the surrounding portion such that a rotating operation and the like is possible. This operating portion 1a may be any suitable shape. In the example in the drawings, the operating portion 1a of the control device 1 has a cylindrical shape.

[0011] FIG 2 is an exploded perspective view of the control device 1 of this example embodiment. As shown in FIG. 2, the control device 1 mainly includes a cap 2, an upper holder 10, a lower holder 20, a middle holder 30, a spring 40, an encoder-side holder 50, an encoder (an encoder element) 60, and a base plate 70.

[0012] The cap 2 forms the operating portion 1a (see FIG. 1) that is exposed to the outside, and has a shape that takes operability into account. In this example, the cap 2 has a cylindrical shape.

[0013] The upper holder 10 includes an annular plate-shaped base portion 12, and leg portions 14 that stand erect from portions near the outer peripheral edge of the base portion 12. The leg portions 14 extend in the axial direction of a center axis X. Three of these leg portions 14 are formed at equal intervals in the circumferential direction. A tip end portion of each leg portion 14 is bent radially outward and has a screw hole 16 formed in it. The tip end portion of each leg portion 14 defines a surface that is perpendicular to the center axis X.

[0014] The lower holder 20 is formed by an annular flat plate. This lower holder 20 extends to substantially the same diameter as the tip end portions of the leg portions 14 of the upper holder 10. The lower holder 20 has three engageable portions 22 at equal intervals in the circumferential direction, and a screw inserting hole 24 is formed in each engageable portion 22. The engageable portions 22 are formed by forming an inner peripheral edge of a central hole (that is basically circular) in the lower holder 20, straight in some parts.

[0015] The middle holder 30 includes an annular plate-shaped base portion 32, and side walls 38 that stand erect from portions near the outer peripheral edge of the base portion 32. Three of these side walls 38 are formed at equal intervals in the circumferential direction. The tip end portion of each side wall 38 has a bent portion 39 that is split into two tabs while bending radially outward. The two tabs of each bent portion 39 are formed such that the width between them is substantially the same (or slightly wider) than the width of the leg portions 14 of the upper holder 10 and the tip end portions of the leg portions 14. The annular base portion 32 includes triangular flat surfaces 34 that extend radially outward between the side walls 38 in the circumferential direction. A screw hole 36 is formed in each flat surface 34.

[0016] The upper holder 10, the lower holder 20, and the middle holder 30 are preferably made of metal, not resin. This is because the upper holder 10, the lower holder 20, and the middle holder 30 must maintain a state (i.e., a structure) in which the spring 40 that generates a strong repulsion force is kept inside, as will be described later.

[0017] The spring 40 may be a coil spring having a cylindrical outer shape. The elastic characteristic of the spring 40 will be described later.

[0018] The encoder-side holder 50 includes a central cylindrical portion 52, and middle holder mounting surfaces 54 that extend radially outward from the central cylindrical portion 52. Three of these middle holder mounting surfaces 54 are formed at equal intervals in the circumferential direction. A hole 56 into which a screw 80 is inserted is formed in each middle holder mounting surface 54.

[0019] The encoder 60 includes a rotating shaft 62 that rotates about the center axis X, and a bearing portion 64 that rotatably supports this rotating shaft 62. One end side of the bearing portion 64 is fixed to the base plate 70.

[0020] The base plate 70 may include a circuit that processes signals from the encoder 60. In this case, the base plate 70 may form a control unit of the on-board audio device.

[0021] Here, an assembly method of the control device 1 shown in FIG 2 will be described. The encoder 60 is arranged on top of the base plate 70 that is attached to the back side of a front panel, and the rotating shaft 62 of the encoder 60 is inserted into the central hole of the lower holder 20. In this state, the middle holder 30 and the encoder-side holder 50 that have been screwed together with the screws 80 are press-fitted onto the tip end of the rotating shaft 62 of the encoder 60. At this time, the rotating shaft 62 of the encoder 60 is fitted into the central cylindrical portion 52 of the encoder-side holder 50. Then, with the spring 40 placed on the annular base portion 32 of the middle holder 30, the upper holder 10 is put on, such that the spring 40 is sandwiched between the upper holder 10 and the middle holder 30. Then, the screw holes 16 in the tip end portions of the three leg portions 14 of the upper holder 10 are aligned with the three screw inserting holes 24 in the lower holder 20 through which the rotating shaft 62 of the encoder 60 had been inserted earlier, and the lower holder 20 and the upper holder 10 are screwed together with screws 82. At this time, the three leg portions 14 of the upper holder 10 are each slidably mounted (in the notch) between the two tabs of the corresponding bent portions 39 provided on the tip ends of the side walls 38 of the middle holder 30. Thus, the upper holder 10 is able to slide in the axial direction of the center axis X while being positioned in the rotational direction with respect to the middle holder 30 (i.e., positioned in the rotational direction with the center axis X as the rotational center, in a plane perpendicular to the center axis X). Finally, and the cap 2 is fixed to the upper holder 10 with double-faced tape 4 inserted between the base portion 12 of the upper holder 10 and the inside of the cap 2.

[0022] The upper holder 10 that is fixed to the cap 2 being screwed to the lower holder 20 in this way results in the middle holder 30 being slidably mounted in the space formed in between. Also, the upper holder 10 (and thus the operating portion 1a) is able to slide in the axial direction of the center axis X by the bent portions 39 on the tip ends of the side walls 38 of the middle holder 30 sliding with respect to the three leg portions 14 of the upper holder 10. Also, the spring 40 is retained between the annular base portion 32 of the middle holder 30 and the base portion 12 of the upper holder 10 by being seated on them. The repulsion force of this spring 40 constantly urges the cap 2, the upper holder 10, and the lower holder 20 as a single unit in the protruding direction. That is, the cap 2, the upper holder 10, and the lower holder 20 form a single unit that is able to slide in the axial direction of the center axis X with respect to the middle holder 30. In the normal state, the cap 2, the upper holder 10, and the lower holder 20 are urged in a direction away from the base plate 70 by the repulsion force of the spring 40, so the cap 2 (i.e., the operating portion 1a) protrudes from the surface of the front panel. The bent portions 39 provided on the tip ends of the side walls 38 of the middle holder 30 abut against the engageable portions 22 (i.e., inner peripheral side portions of the screw inserting hole 24) of the lower holder 20 to serve as stoppers, so the height of the cap 2 with respect to the front panel is fixed.

[0023] FIGS. 3A, 3B, and 3C are perspective views of the exterior of the control device 1 in each state. FIGS. 4A, 4B, and 4C are perspective views of the main portions of the control device 1 in each state. FIGS. 5A, 5B, and 5C are perspective views of the encoder 60 of the control device 1 in each state. FIGS. 6A, 6B, and 6C are perspective views of the internal mechanism of the control device 1 in each state. In FIGS. 3A, 3B, 3C to 6A, 6B, and 6C, FIGS. 3A to 6A show a normal state (i.e., an unloaded state) in which no load is applied to the control device 1, FIGS. 3B to 6B show a partially pushed in state when an operating load (i.e., the load when being pushed) is applied to the control device 1, and FIGS. 3C to 6C show a fully pushed in state when a large load has been applied to the control device 1. FIGS. 4A, 4B, and 4C show the inside through the cap 2.

[0024] During normal operation, when the cap 2 is turned in the rotational direction, the cap 2, the upper holder 10, the lower holder 20, the spring 40, the middle holder 30, the encoder-side holder 50, and the rotating shaft 62 of the encoder 60 all rotate together, such that a normal rotating operation is realized. At this time, transmission of the rotating operation from the upper holder 10 to the middle holder 30 is realized by contact (i.e., abutment) in the circumferential direction between the bent portions 39 of the side walls 38 of the middle holder 30 and the three leg portions 14 of the upper holder 10. Also, when the cap 2 is pushed in in the axial direction of the center axis X, the cap 2, the upper holder 10, the lower holder 20, the spring 40, the middle holder 30, the encoder-side holder 50, and the rotating shaft 62 of the encoder 60 are depressed as a single unit, such that a normal push-in operation (i.e., a push operation) is realized (see FIGS. 3B, 4B, 5B, and 6B). In FIG. 3B, only the control device 1 on the left side in the drawing is operated.

[0025] In this way, in a normal operation, pressing force that exceeds the repulsion force of the spring 40 is not applied, so the spring 40 essentially does not further deform, thus a push operation and a rotating operation are possible within the operating range (i.e., within a predetermined operating stroke) of the encoder 60 itself. In the example shown, the operating range (i.e., the predetermined operating stroke) of the encoder 60 itself is specified by $\Delta D1$ as shown in FIGS. 4A to 4C and FIGS. 5A to 5C.

[0026] Meanwhile, when a large load is applied in the direction that pushes the cap 2 in (i.e., in the direction that reduces the protrusion amount) in the axial direction of the center axis X, the cap 2, the upper holder 10, and the lower holder 20 slide toward the base plate 70 with the bent portions 39 at the tip ends of the side walls 38 of the middle holder 30 sliding with respect to the three leg portions 14 of the upper holder 10, as shown in FIGS. 3C, 4C, 5C, and 6C. That is, when a large load is applied to the cap 2 in the direction that pushes the cap 2 in in the axial direction of the center axis X, the spring 40 elastically deforms in the compression direction, such that the cap 2, the upper holder 10, and the lower holder 20 exceed the operating range (i.e., the maximum stroke amount within the predetermined operation stroke) of the encoder 60 itself and move toward the base plate 70. Therefore, when a large load (i.e., a load significantly larger than the load applied during a normal push operation) is applied to the cap 2 in a direction that pushes the cap 2 in in the axial direction of the center axis X, the protrusion amount of the cap 2 is able to be reduced beyond the reduction amount that is possible within the operating range of the encoder 60 itself (see the reduction amount $\Delta D1$ in FIGS. 4A to 4C). In the example shown, the protrusion amount of the cap 2 is further reduced by $\Delta D2$ from the partially pushed in state, and is thus reduced by the sum of $\Delta D1 + \Delta D2$ from the normal state (see FIGS. 4A to 4C). Typically, $\Delta D2$ is significantly larger than $\Delta D1$.

[0027] Also, when this kind of large load is removed, the cap 2, the upper holder 10, and the lower holder 20 slide back to the original state (i.e., the normal state), as shown in FIGS. 3A, 4A, 5A, and 6A, with the bent portions 39 at the tip ends of the side walls 38 of the middle holder 30 sliding with respect to the three leg portions 14 of the upper holder 10. That is, when this kind of a large load is removed, the spring 40 is elastically restored to its original state, so the bent portions 39 provided on the tip ends of the side walls 38 of the middle holder 30 slide until they abut against the engageable portions 22 of the lower holder 20 and are restored to their original state.

[0028] Next, the elastic characteristic of the spring 40 will be described. FIG. 7 is a graph of an example of an elastic characteristic of the spring 40. In FIG. 7, the horizontal axis represents the protrusion amount of the cap 2 with respect to a reference surface, and the vertical axis represents the repulsion force (i.e., the load) of the spring 40. Here, the reference surface may be any appropriate surface. For example, for the reference surface, a position where a member (such as the front panel) provided on the outer peripheral side of the cap 2 protrudes the most may be set as the reference, as shown in FIGS. 4A to 4C.

[0029] In FIG. 7, the protrusion amount D2 is a protrusion amount in the partially pushed in state (i.e., the state shown in FIG. 3B). In the example shown in FIG. 7, the spring 40 has a linear elastic characteristic. The spring 40 is retained between the base portion 32 and the base portion 12 of the upper holder 10 in an elastically deformed state. That is, in the partially pushed in state, the spring 40 is elastically deformed in the compression direction between the annular base portion 32 and the base portion 12 of the upper holder 10, such that a repulsion force N1 is generated. When the load in the direction that pushes the cap 2 in in the axial direction of the center axis X exceeds the repulsion force N1, the spring 40 elastically deforms further, such that the protrusion amount decreases linearly. In the example shown in FIG 7, the spring 40 generates a repulsion force N2 when the protrusion amount of the cap 2 with respect to the reference surface is zero.

[0030] The repulsion force N1 may be set to a value that is significantly larger than the load (i.e., the push load) that is applied to the encoder 60 during a normal push operation. More specifically, repulsion force N1 may be a value that is equal to or greater than 2.5 times the push load. For example, when the push load is approximately 2 [N], the repulsion force N1 may be equal to or greater than 5 [N]. It is assumed that with a normal push operation, the protrusion amount of the cap 2 is reduced slightly within the operating range (i.e., the predetermined operating stroke) of the encoder 60 itself, and the protrusion amount of the cap 2 with respect to the reference surface is significantly greater than zero even at the maximum stroke within the operating stroke (see $\Delta D2$ in FIGS. 4A to 4C).

[0031] The repulsion force N2 may be set to a value that is greater than the load that is applied when part of the body such as a knee of an occupant (i.e., an operator) strikes the control device 1 unrelated to a collision. As a result, the cap 2 (i.e., the operating portion 1a) is prevented from being damaged when part of the body of the occupant unintentionally strikes the control device 1 unrelated to a collision, which enables good merchantability to be maintained. For example, the repulsion force N2 may be set to a value greater than 10 [N] that is significantly (e.g., at least two times) 5 [N].

[0032] Also, the repulsion force N2 is set to a value less than a predetermined upper limit value. The predetermined upper limit value may be arbitrary, but typically it is set at a value less than an interior impact specified load set forth by a regulation or the like. For example, according to a regulation (ECE No. 21) related to an interior impact test for Europe, when a load of equal to or greater than 378 [N] is applied to the operating portion 1a, the protrusion amount of the operating portion 1a from a grille surface must be no more than a predetermined amount 9.5 mm. Therefore, when the reference surface is a surface of a predetermined height (9.5 mm) from the grille surface, the repulsion force N2 is set to a value less than 378 [N]. For example, the repulsion force N2 may be approximately 100 [N], as a value that is greater than 10 [N] and less than 378 [N].

[0033] The control device 1 according to the example embodiment described above displays the effects described below in particular. According to the control device 1 of this example embodiment, even if a load that is significantly larger than normal is applied, the tip end portion of the cap 2 (i.e., the operating portion 1a) is able to be depressed to the reference surface (such as the same surface as the surrounding front panel) or lower, so the mounting structure will not be damaged. As a result, for example, the interior impact standard can be satisfied, and the cap 2 (i.e., the operating portion 1a) can be returned to its initial position again (see FIG. 6A) when the significantly large load is removed.

[0034] When the control device 1 that is operated in the rotational direction to make an adjustment, e.g., to adjust the volume, typically the operating portion 1a is made comparatively large in size so that small adjustments can be performed easily, and the protrusion amount tends to be large. Therefore, the control device 1 that includes this type of operating portion 1a is easy to operate, but on the other hand, is also easily bumped by a knee of an occupant, so a load that is significantly larger than a normally assumed load may be applied to the control device 1. Accordingly, this example embodiment is particularly preferable for the control device 1 that includes this operating portion 1a.

[0035] Also, the cap 2 preferably has a peripheral portion 2a that has a larger outer diameter than the outer diameters of the upper holder 10, the lower holder 20, the middle holder 30, the spring 40, and the encoder-side holder 50. That is, the upper holder 10, the lower holder 20, the middle holder 30, the spring 40, and the encoder-side holder 50 preferably fit radially inside of the surrounding portion 2a of the cap 2. As a result, all of the members that are press-fit onto the rotating shaft 62 of the encoder 60 (i.e., the cap 2, the upper holder 10, the lower holder 20, the middle holder 30, the spring 40, and the encoder-side holder 50) are able to be removed from, as well as attached to, the rotating shaft 62 of the encoder

60 in an assembled state (ASSY state), which facilitates replacement of these parts during servicing. Also, as another effect, the design is enhanced when the surrounding portion 2a of the cap 2 is illuminated, which enables merchantability to be increased. That is, in the assembled state, a gap is formed in the radial direction between the surrounding portion 2a of the cap 2 and a hole formed in the front panel (i.e., the grille), but there is no structural object that protrudes farther out than the outer shape of the cap 2, so illuminated light can pass through the gap between the surrounding portion 2a of the cap 2 and the front panel. On the other hand, using a space larger than the outer shape of the cap 2 on the inside of the front panel in order to handle a large spring load such as that described above increases the degree of design freedom, but with a structure in which a structural object (such as the upper holder 10 or the lower holder 20) protrudes farther than the outer shape of the cap 2, the illuminated light is blocked by the protruding portion, so the illuminated light is unable to pass through the gap between the surrounding portion 2a of the cap 2 and the front panel.

[0036] Heretofore, an example embodiment of the invention has been described in detail, but the invention is not limited to this example embodiment. That is, various modifications and substitutions may be applied to the example embodiment described above without departing from the scope of the invention defined in the appended claims.

[0037] For example, in the example embodiment described above, the spring 40 has a linear elastic characteristic, but a nonlinear elastic characteristic may also be realized by combining a plurality of springs, for example. Also, the spring 40 may be substituted for another elastic member such as rubber.

[0038] Also, in the example embodiment described above, in the normal state and the partially pushed in state (see FIGS. 6A and 6B), the spring 40 is retained between the annular base portion 32 and the base portion 12 of the upper holder 10 in an elastically deformed state. However, the spring 40 may also be retained (in a state with no play) between the annular base portion 32 of the middle holder 30 and the base portion 12 of the upper holder 10, so that it is normally substantially free. In this case, the elastic characteristic of the spring 40 is as shown as in FIG 8, for example. Also in this case, in the normal state and the partially pushed in state (see FIGS. 6A and 6B), the repulsion force of the spring 40 is essentially zero, so the necessary strength and durability of the structure (e.g., the fastening portion between the upper holder 10 and the lower holder 20) that retains the spring 40 can be reduced.

[0039] Also, in the example embodiment described above, the mode in which the three leg portions 14 of the upper holder 10 slide with respect to the bent portions 39 on the tip ends of the side walls 38 of the middle holder 30 during sliding may or may not be accompanied by friction. However, when there is no friction, the gap (i.e., play) between the three leg portions 14 of the upper holder 10 and the bent portions 39 on the tip ends of the side walls 38 of the middle holder 30 may be reduced as much as possible without losing operability of the rotating operation.

[0040] Also, in the description above, a specific mechanism is described as the mechanism for restoring the protruding portion when the protruding portion is fully pushed in only when a significantly large load is applied and then that load is removed. However, there are a wide variety of these mechanisms. For example, in the example embodiment described above, the middle holder 30 is fixed to the encoder 60 side, and the upper holder 10 is fixed to the cap 2 (i.e., the operating portion 1a) side, but the reverse is also possible. That is, the cap 2 (i.e., the operating portion 1a) may be fixed to the middle holder 30 side, and the encoder 60 may be fixed to the upper holder 10 side. In this case, the middle holder 30 is urged by the spring 40 in the protruding direction of the operating portion 1a, and the lower holder 20 (i.e., the engageable portions 22) abuts against the middle holder 30 to serve as a stopper.

[0041] Also, as shown in FIG. 9, for example, the invention may also be realized by a mechanism in which an operating portion side member 100 is urged in the protruding direction by the spring 40, and that includes a retaining member 200 that stops the operating portion side member 100 from moving in the protruding direction. In the example shown in FIG. 9, the retaining member 200 has a retaining portion 202 that stops the operating portion side member 100 from moving in the protruding direction. The retaining member 200 is connected to an encoder side member 300 (such as an encoder side holder or an encoder) in a state in which the retaining member 200 is unable to protrude in the protruding direction and unable to rotate with respect to the encoder side member 300. Also, the operating portion side member 100 and the retaining member 200 are configured such that the operating portion side member 100 is able to slide in the direction that reduces the protrusion amount with respect to the retaining member 200, and a rotating operation is able to be transmitted from the operating portion side member 100 to the retaining member 200, similar to the relationship between the bent portions 39 on the tip ends of the side walls 38 of the middle holder 30 and the three leg portions 14 of the upper holder 10 described above. The operating portion side member 100 may also be formed by a plurality of members such as the cap 2, the upper holder 10, and the lower holder 20 in the example embodiment described above, for example. The same also applies to the retaining member 200. With the structure shown in FIG. 9 as well, the side where the operating portion is attached and the side where the encoder is attached may be reversed, just like the structure according to the example embodiment described above.

[0042] Also, with a control device in which only a push-in operation is possible, in principle, it is sufficient to have just the characteristics described below. (1) The operating portion 1 a is urged by the spring 40 in the protruding direction. (2) There is a stopper portion (i.e., a retaining member) that stops the operating portion 1a from moving in the protruding direction. (3) A push-in operation of the operating portion 1a is transmitted to the encoder 60.

[0043] Also, with a control device in which only a rotating operation is possible, in principle, it is sufficient to have just the characteristics described below. (1) The operating portion 1a is urged by the spring 40 in the protruding direction. (2) There is a stopper portion (i.e., a retaining member) that stops the operating portion 1a from moving in the protruding direction. (3) A rotating operation of the operating portion 1a is transmitted to the encoder 60. In this case, the stopper portion may rotate together with the rotating shaft 62 of the encoder 60. Moreover, in this case, the rotating operation of the operating portion 1a may be transmitted to the rotating shaft 62 of the encoder 60.

Claims

1. A control device (1) that includes a base plate (70), an operating portion (1a) that protrudes from a reference surface located apart from the base plate (70), an elastic body (40), the elastic body having a repulsion force urging the operating portion (1a) in a protruding direction that increases a protrusion amount,
and an encoder (60) that is attached to the base plate (70);
characterised by further comprising:

    a first holder (10) that is provided on the operating portion (1a) side and that is fixed to the operating portion (1a) and is made of metal;
    a second holder (20) that is provided on the encoder (60) side and that is fixed to the first holder (10) and is made of metal; and
    a middle holder (30) that is fixed to the encoder (60) and is made of metal, wherein the middle holder (30) includes an engaging portion (39) that stops the second holder (20) from moving with respect to the encoder (60), that is movement in a direction that increases the protrusion amount of the operating portion (1a);
    wherein, if a load that is equal to or greater than a predetermined load and exceeds the repulsion force of the elastic body (40) is applied to the operating portion (1a) in a direction that reduces a protrusion amount, the operating portion (1a) moves more than a maximum stroke amount within a predetermined operating stroke against the repulsion force of the elastic body (40) in the direction in which the protrusion amount decreases, the operating portion (1a) being supported via the elastic body (40) so as to return to an original protrusion amount by a restoring force of the elastic body (40) when the load is removed; and
    the elastic body (40) is arranged between the middle holder (30) and the first holder (10).

2. The control device (1) according to claim 1, **characterized in that** the engaging portion (39) of the middle holder (30) has tab portions; a portion of the first holder (10) is mounted passing between the tab portions; and the first holder (10) is able to slide in a moving direction of the operating portion (1a) with respect to the middle holder (30).

3. A control device (1) that includes a base plate (70), an operating portion (1a) that protrudes from a reference surface located apart from the base plate (70), an elastic body (40), the elastic body having a repulsion force urging the operating portion (1a) in a protruding direction that increases a protrusion amount, and an encoder (60) that is attached to the base plate (70);
characterised by further comprising:

    a first holder (10) that is provided on the encoder (60) side and that is fixed to the encoder (60) and is made of metal;
    a second holder (20) that is provided on the operating portion (1a) side and that is fixed to the first holder (10) and is made of metal; and
    a middle holder (30) that is fixed to the operating portion (1a) and is made of metal,
    wherein the second holder (20) includes an engaging portion (22) that stops the middle holder (30) from moving with respect to the operating portion (1a), that is movement in a direction that increases the protrusion amount of the operating portion (1a);
    wherein, if a load that is equal to or greater than a predetermined load and exceeds the repulsion force of the elastic body (40) is applied to the operating portion (1a) in a direction that reduces a protrusion amount, the operating portion (1a) moves more than a maximum stroke amount within a predetermined operating stroke against the repulsion force of the elastic body (40) in the direction in which the protrusion amount decreases, the operating portion (1a) being supported via the elastic body (40) so as to return to an original protrusion amount by a restoring force of the elastic body (40) when the load is removed; and
    the elastic body (40) is arranged between the middle holder (30) and the first holder (10).

4. The control device (1) according to any one of claims 1 through 3, **characterized by** further comprising:

    a cap (2) that is a cap that forms the operating

portion (1a), and that has an outer diameter that is smaller than a hole formed in a panel member on which the control device (1) is arranged, and that protrudes from the hole,
wherein all component parts of the control device (1) that are positioned on the cap (2) side of the encoder (60) are arranged so as to fit radially inside of the outer diameter of the cap (2).

5. The control device (1) according to claim 1 or 3, **characterized in that** the operating portion (1a) moves to equal to or below the reference surface in response to the load of equal to or greater than the predetermined load.

6. The control device according to claim 1 or 3, **characterized in that** the predetermined load is greater than 10 [N] and less than 378 [N].

7. The control device according to any one of claims 1 through 6, **characterized in that** the operating portion (1a) is able to be rotated in a plane perpendicular to a center axis of the direction that reduces the protrusion amount, and the maximum stroke amount within the operating stroke is zero.

8. The control device (1) according to any one of claims 1 through 6, **characterized in that** the operating portion (1a) is able to be pushed in the direction that reduces the protrusion amount; the maximum stroke amount within the operating stroke is greater than zero; and the operating portion (1a) remains protruding from the reference surface when pushed in by the maximum stroke amount.

9. The control device (1) according to claim 1 or 3, **characterized in that** the operating portion (1a) is able be rotated, and a rotating operation with respect to the operating portion (1a) is transmitted to the encoder (60) via the engaging member (30, 200).

10. The control device (1) according to claim 9, **characterized in that** the operating portion (1a) is able to be pushed in in the direction that reduces the protrusion amount; and a push-in operation with respect to the operating portion (1a) is transmitted to the encoder (60) via the elastic body (40).

Patentansprüche

1. Steuervorrichtung (1), die eine Basisplatte (70), einen Betriebsabschnitt (1a), der von einer Referenzoberfläche hervorsteht, die von der Basisplatte (70) entfernt angeordnet ist, einen elastischen Körper (40), wobei der elastische Körper eine Abstoßkraft aufweist, die den Betriebsabschnitt (1a) in eine hervorstehende Richtung drückt, die ein Ausmaß des Hervorstehens erhöht, und einen Kodierer (60) beinhaltet, der an der Basisplatte (70) befestigt ist; **dadurch gekennzeichnet, dass** sie ferner aufweist:

einen ersten Halter (10), der sich auf der Betriebsabschnittsseite befindet und der an dem Betriebsabschnitt (1a) befestigt ist und aus Metall besteht;
einen zweiten Halter (20), der sich an der Kodiererseite befindet und der an dem ersten Halter (10) befestigt ist und aus Metall besteht; und
einen mittleren Halter (30), der an dem Kodierer (60) befestigt ist und aus Metall besteht,
wobei der mittlere Halter (30) einen Eingriffsabschnitt (39) beinhaltet, der den zweiten Halter (20) davon abhält, sich im Verhältnis zu dem Kodierer (60) zu bewegen, d.h. eine Bewegung in eine Richtung, die das Ausmaß des Hervorstehens des Betriebsabschnitts (1a) erhöht;
wobei, falls eine Last, die einer vorgegebenen Last gleicht oder größer als diese ist und die Abstoßkraft des elastischen Körpers (40) überschreitet, auf den Betriebsabschnitt (1a) in einer Richtung ausgeübt wird, die ein Ausmaß des Hervorstehens verringert, sich der Betriebsabschnitt (1a) um mehr als einen maximalen Hubbetrag innerhalb eines vorgegebenen Betriebshubs gegen die Abstoßkraft des elastischen Körpers (40) in der Richtung bewegt, in der das Ausmaß des Hervorstehens abnimmt, wobei der Betriebsabschnitt (1a) über den elastischen Körper (40) gestützt wird, so dass er zu einem ursprünglichen Ausmaß des Hervorstehens durch eine Wiederherstellungskraft des elastischen Körpers (40) zurückkehrt, wenn die Last entfernt wird; und
wobei der elastische Körper (40) zwischen dem mittleren Halter (30) und dem ersten Halter (10) angeordnet ist.

2. Steuervorrichtung (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** der Eingriffsabschnitt (39) des mittleren Halters (30) Streifenabschnitte aufweist; ein Abschnitt des ersten Halters (10) zwischen den Streifenabschnitten befestigt ist; und der erste Halter (10) in der Lage ist, in einer Bewegungsrichtung des Betriebsabschnitts (1a) im Verhältnis zu dem mittleren Halter (30) zu gleiten.

3. Steuervorrichtung (1), die eine Basisplatte (70), einen Betriebsabschnitt (1a), der von einer Referenzoberfläche hervorsteht, die von der Basisplatte (70) entfernt angeordnet ist, einen elastischen Körper (40), wobei der elastische Körper eine Abstoßkraft aufweist, die den Betriebsabschnitt (1a) in eine hervorstehende Richtung drückt, die ein Ausmaß des Hervorstehens erhöht, und einen Kodierer (60) beinhaltet, der an der Basisplatte (70) befestigt ist;

dadurch gekennzeichnet, dass sie ferner aufweist:

einen ersten Halter (10), der sich auf der Kodiererseite befindet und der an dem Kodierer (60) befestigt ist und aus Metall besteht;
einen zweiten Halter (20), der sich an der Betriebsabschnittsseite befindet und der an dem ersten Halter (10) befestigt ist und aus Metall besteht; und
einen mittleren Halter (30), der an dem Betriebsabschnitt (1a) befestigt ist und aus Metall besteht,
wobei der zweite Halter (20) einen Eingriffsabschnitt (22) beinhaltet, der den mittleren Halter (30) davon abhält, sich im Verhältnis zu dem Betriebsabschnitt (1a) zu bewegen, d.h. eine Bewegung in eine Richtung, die das Ausmaß des Hervorstehens des Betriebsabschnitts (1a) erhöht;
wobei, falls eine Last, die einer vorgegebenen Last gleicht oder größer als diese ist und die Abstoßkraft des elastischen Körpers (40) überschreitet, auf den Betriebsabschnitt (1a) in einer Richtung ausgeübt wird, die ein Ausmaß des Hervorstehens verringert, sich der Betriebsabschnitt (1a) um mehr als einen maximalen Hubbetrag innerhalb eines vorgegebenen Betriebshubs gegen die Abstoßkraft des elastischen Körpers (40) in der Richtung bewegt, in der das Ausmaß des Hervorstehens abnimmt, wobei der Betriebsabschnitt (1a) über den elastischen Körper (40) gestützt wird, so dass er zu einem ursprünglichen Ausmaß des Hervorstehens durch eine Wiederherstellungskraft des elastischen Körpers (40) zurückkehrt, wenn die Last entfernt wird; und
wobei der elastische Körper (40) zwischen dem mittleren Halter (30) und dem ersten Halter (10) angeordnet ist.

4. Steuervorrichtung (1) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** sie ferner aufweist:

eine Kappe (2), bei der es sich um eine Kappe handelt, die den Betriebsabschnitt (1a) bildet, und die einen Außendurchmesser aufweist, der kleiner ist als ein Loch,
das in einem Panelelement ausgebildet ist, auf dem die Steuervorrichtung (1) angeordnet ist, und die aus dem Loch hervorragt,
wobei alle Komponententeile der Steuervorrichtung (1), die auf der Kappenseite des Kodierers (60) positioniert sind, so angeordnet sind, dass sie radial in den Außendurchmesser der Kappe (2) passen.

5. Steuervorrichtung (1) nach Anspruch 1 oder 3, **dadurch gekennzeichnet, dass** sich der Betriebsabschnitt (1a) als Reaktion auf die Last, die der vorgegebenen Last gleicht oder größer als die vorgegebene Last ist, auf die Referenzoberfläche oder unterhalb der Referenzoberfläche bewegt.

6. Steuervorrichtung nach Anspruch 1 oder 3, **dadurch gekennzeichnet, dass** die vorgegebene Last größer ist als 10 [N] und geringer als 378 [N].

7. Steuervorrichtung nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** der Betriebsabschnitt (1a) in der Lage ist, in einer Ebene gedreht zu werden, die zu einer Mittelachse der Richtung rechtwinklig ist, die das Ausmaß des Hervorstehens verringert, und der maximale Hubbetrag in dem Betriebstakt Null ist.

8. Steuervorrichtung (1) nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** der Betriebsabschnitt (1a) in der Lage ist, in die Richtung gedrückt zu werden, die das Ausmaß des Hervorstehens verringert; wobei der maximale Hubbetrag innerhalb des Betriebshubs größer als Null ist; und wobei der Betriebsabschnitt (1 a) weiterhin von der Referenzoberfläche hervorsteht, wenn er mit dem maximalen Hubbetrag eingedrückt wird.

9. Steuervorrichtung (1) nach Anspruch 1 oder 3, **dadurch gekennzeichnet, dass** der Betriebsabschnitt (1a) gedreht werden kann, und ein Drehvorgang im Verhältnis zu dem Betriebsabschnitt (1a) über das Eingriffselement (30, 200) an den Kodierer (60) übertragen wird.

10. Steuervorrichtung (1) nach Anspruch 9, **dadurch gekennzeichnet, dass** der Betriebsabschnitt (1a) in der Lage ist, in der Richtung eingedrückt zu werden, die das Ausmaß des Hervorstehens verringert; und ein Eindrückvorgang im Verhältnis zu dem Betriebsabschnitt (1a) über den elastischen Körper (40) an den Kodierer (60) übertragen wird.

Revendications

1. Dispositif de commande (1) qui comprend une plaque de base (70), une partie opérationnelle (1a) qui fait saillie d'une surface de référence positionnée à distance de la plaque de base (70), un corps élastique (40), le corps élastique ayant une force de répulsion poussant la partie opérationnelle (1a) dans une direction de saillie qui augmente une quantité de saillie, et un encodeur (60) qui est fixé à la plaque de base (70) ;
caractérisé en ce qu'il comprend en outre :

un premier support (10) qui est prévu du côté

de la partie opérationnelle (1a) et qui est fixé sur la partie opérationnelle (1a) et est réalisé à partir de métal ;
un second support (20) qui est prévu du côté de l'encodeur (60) et qui est fixé sur le premier support (10) et est réalisé à partir de métal ; et
un support central (30) qui est fixé sur l'encodeur (60) et est réalisé à partir de métal,
dans lequel le support central (30) comprend une partie de mise en prise (39) qui empêche le second support (20) de se déplacer par rapport à l'encodeur (60), qui est un mouvement dans une direction qui augmente la quantité de saillie de la partie opérationnelle (1a) ;
dans lequel, si une charge, qui est égale ou supérieure à une charge prédéterminée et dépasse la force de répulsion du corps élastique (40), est appliquée sur la partie opérationnelle (1a) dans une direction qui réduit une quantité de saillie, la partie opérationnelle (1a) se déplace plus qu'une quantité de course maximum dans une course opérationnelle prédéterminée contre la force de répulsion du corps élastique (40) dans la direction dans laquelle la quantité de saillie diminue, la partie opérationnelle (1a) étant supportée via le corps élastique (40) afin de revenir à une quantité de saillie d'origine par une force de rappel du corps élastique (40) lorsque la charge est retirée ; et
le corps élastique (40) est agencé entre le support central (30) et le premier support (10).

2. Dispositif de commande (1) selon la revendication 1, **caractérisé en ce que** la partie de mise en prise (39) du support central (30) a des parties de languette ; une partie du premier support (10) est montée en passant entre les parties de languette ; et le premier support (10) peut coulisser dans une direction de déplacement de la partie opérationnelle (1a) par rapport au support central (30).

3. Dispositif de commande (1) qui comprend une plaque de base (70), une partie opérationnelle (1a) qui fait saillie d'une surface de référence positionnée à distance de la plaque de base (70), un corps élastique (40), le corps élastique ayant une force de répulsion poussant la partie opérationnelle (1a) dans une direction de saillie qui augmente une quantité de saillie, et un encodeur (60) qui est fixé à la plaque de base (70) ;
caractérisé en ce qu'il comprend en outre :

un premier support (10) qui est prévu du côté de l'encodeur (60) et qui est fixé sur l'encodeur (60) et est réalisé à partir de métal ;
un second support (20) qui est prévu du côté de la partie opérationnelle (1a) et qui est fixé sur le premier support (10) et est réalisé à partir de métal ; et
un support central (30) qui est fixé sur la partie opérationnelle (1a) et est réalisé à partir de métal,
dans lequel le second support (20) comprend une partie de mise en prise (22) qui empêche le support central (30) de se déplacer par rapport à la partie opérationnelle (1a), qui est un mouvement dans une direction qui augmente la quantité de saillie de la partie opérationnelle (1a) ;
dans lequel, si une charge, qui est égale ou supérieure à une charge prédéterminée et dépasse la force de répulsion du corps élastique (40), est appliquée sur la partie opérationnelle (1a) dans une direction qui réduit une quantité de saillie, la partie opérationnelle (1a) se déplace plus qu'une quantité de course maximum dans une course opérationnelle prédéterminée contre la force de répulsion du corps élastique (40) dans la direction dans laquelle la quantité de saillie diminue, la partie opérationnelle (1a) étant supportée via le corps élastique (40) afin de revenir à une quantité de saillie d'origine par une force de rappel du corps élastique (40) lorsque la charge est retirée ; et
le corps élastique (40) est agencé entre le support central (30) et le premier support (10).

4. Dispositif de commande (1) selon l'une quelconque des revendications 1 à 3, **caractérisé en ce qu'**il comprend en outre :

un capuchon (2) qui est un capuchon qui forme la partie opérationnelle (1a) et qui a un diamètre externe qui est inférieur à un trou formé dans un élément de panneau sur lequel le dispositif de commande (1) est agencé, et qui fait saillie du trou,
dans lequel toutes les parties de composant du dispositif de commande (1) qui sont positionnées du côté du capuchon (2) de l'encodeur (60) sont agencées afin de se monter radialement à l'intérieur du diamètre externe du capuchon (2).

5. Dispositif de commande (1) selon la revendication 1 ou 3, **caractérisé en ce que** la partie opérationnelle (1a) se déplace au même niveau que ou au-dessous de la surface de référence en réponse à la charge égale ou supérieure à la charge prédéterminée.

6. Dispositif de commande selon la revendication 1 ou 3, **caractérisé en ce que** la charge prédéterminée est supérieure à 10[N] et inférieure à 378 [N].

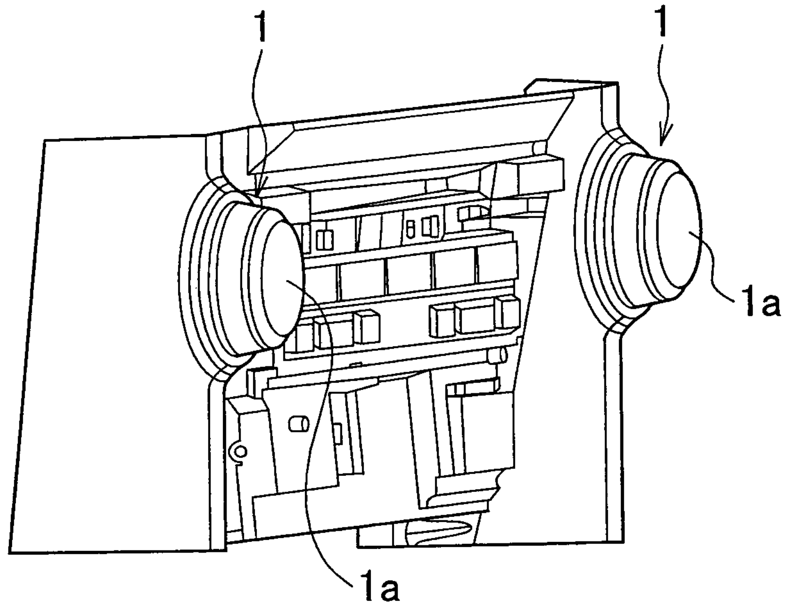
7. Dispositif de commande selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** la partie opérationnelle (1a) peut être entraînée en rotation dans un plan perpendiculaire à un axe central de la direction qui réduit la quantité de saillie, et la quantité de course maximum dans la course opérationnelle est nulle.

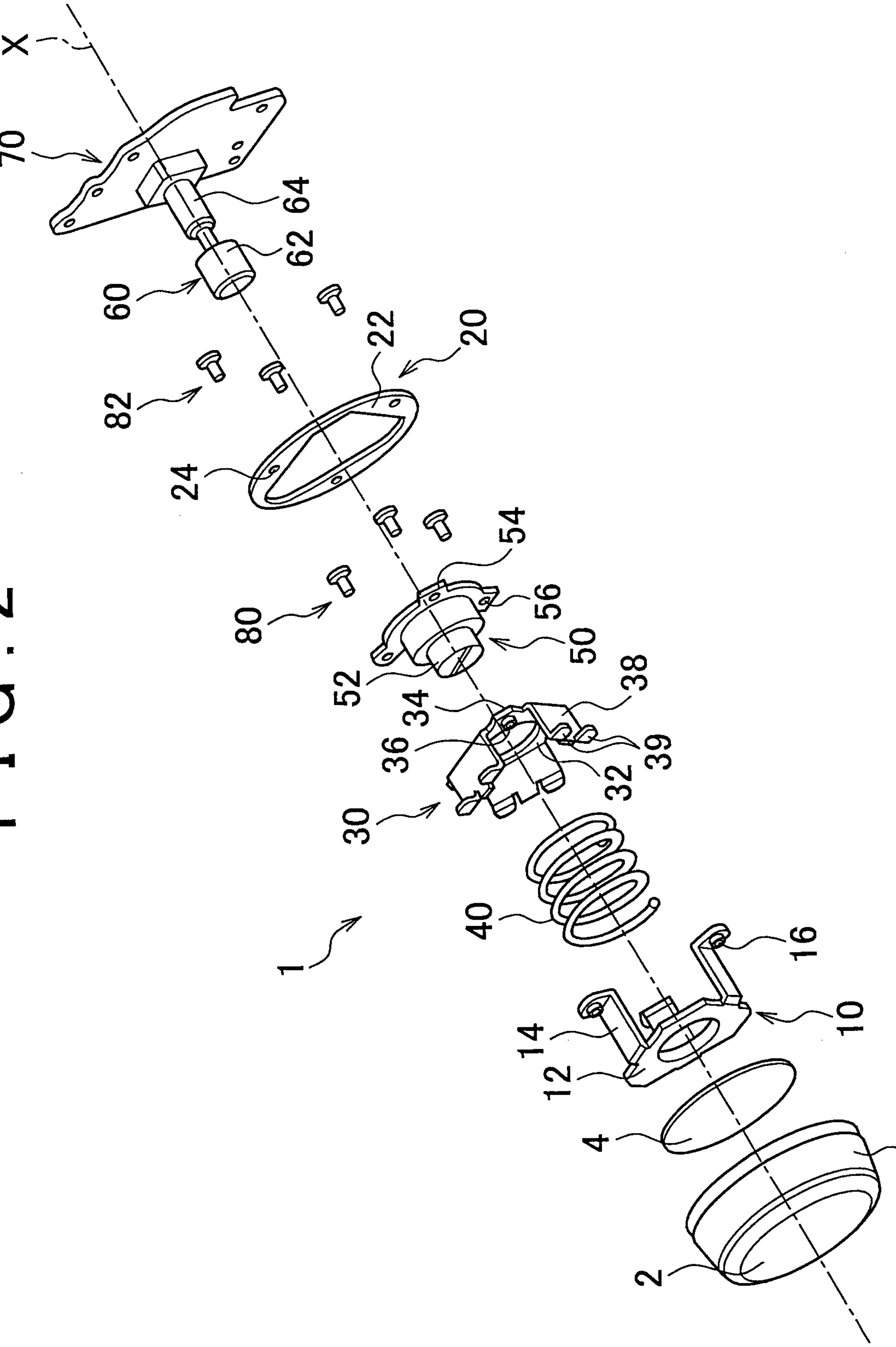
8. Dispositif de commande (1) selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** la partie opérationnelle (1a) peut être poussée dans la direction qui réduit la quantité de saillie ; la quantité de course maximum dans la course opérationnelle est supérieure à zéro ; et la partie opérationnelle (1a) reste en saillie par rapport à la surface de référence lorsqu'elle est poussée par la quantité de course maximum.

9. Dispositif de commande (1) selon la revendication 1 ou 3, **caractérisé en ce que** la partie opérationnelle (1a) peut être entraînée en rotation, et une opération de rotation par rapport à la partie opérationnelle (1a) est transmise à l'encodeur (60) via l'élément de mise en prise (30, 200).

10. Dispositif de commande (1) selon la revendication 9, **caractérisé en ce que** la partie opérationnelle (1a) peut être poussée dans la direction qui réduit la quantité de saillie ; et une opération de poussée par rapport à la partie opérationnelle (1a) est transmise à l'encodeur (60) via le corps élastique (40).

FIG. 1




X
70
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24
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56
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1
16
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14
12
4
2a
2

FIG. 2

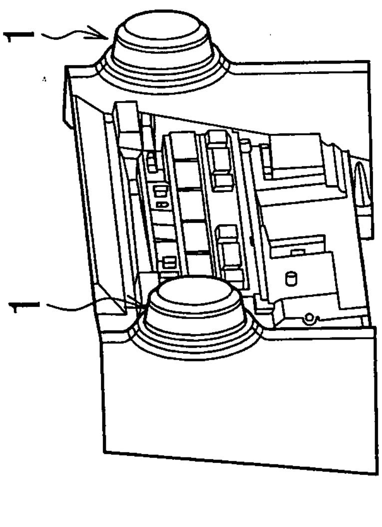


FIG. 3A

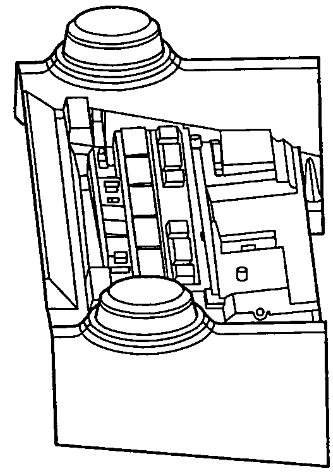


FIG. 3B

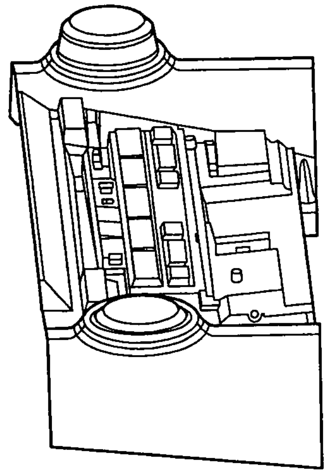


FIG. 3C

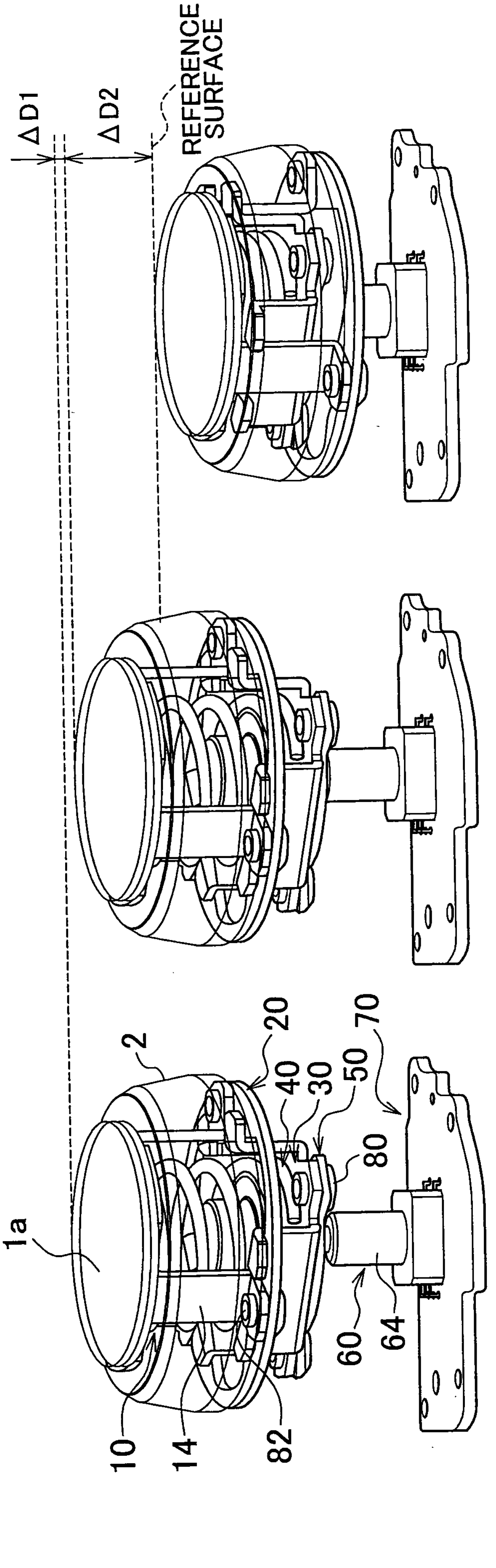


FIG. 4A

FIG. 4B

FIG. 4C

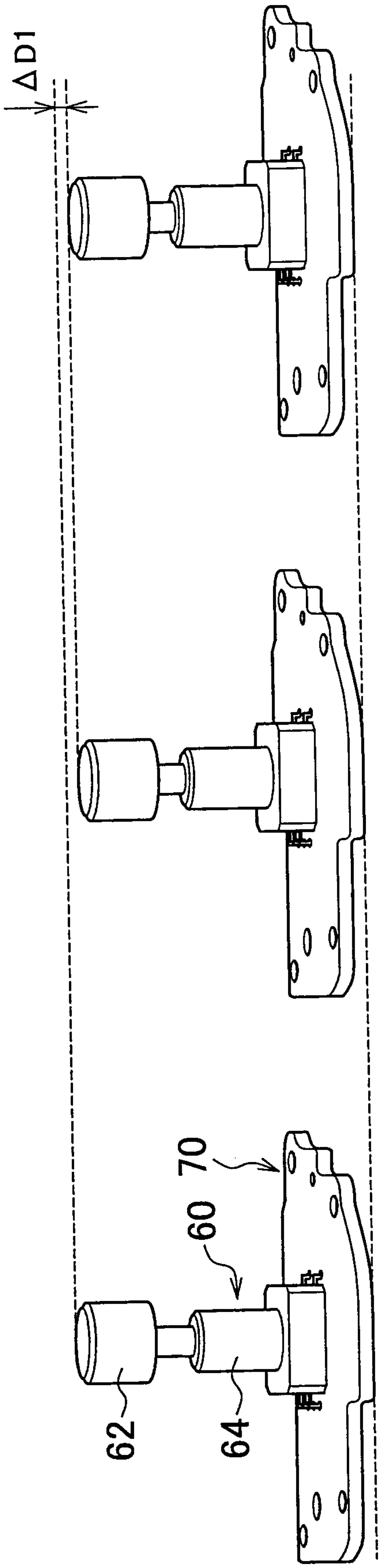


FIG. 5A

FIG. 5B

FIG. 5C

FIG. 6C

FIG. 6B

FIG. 6A

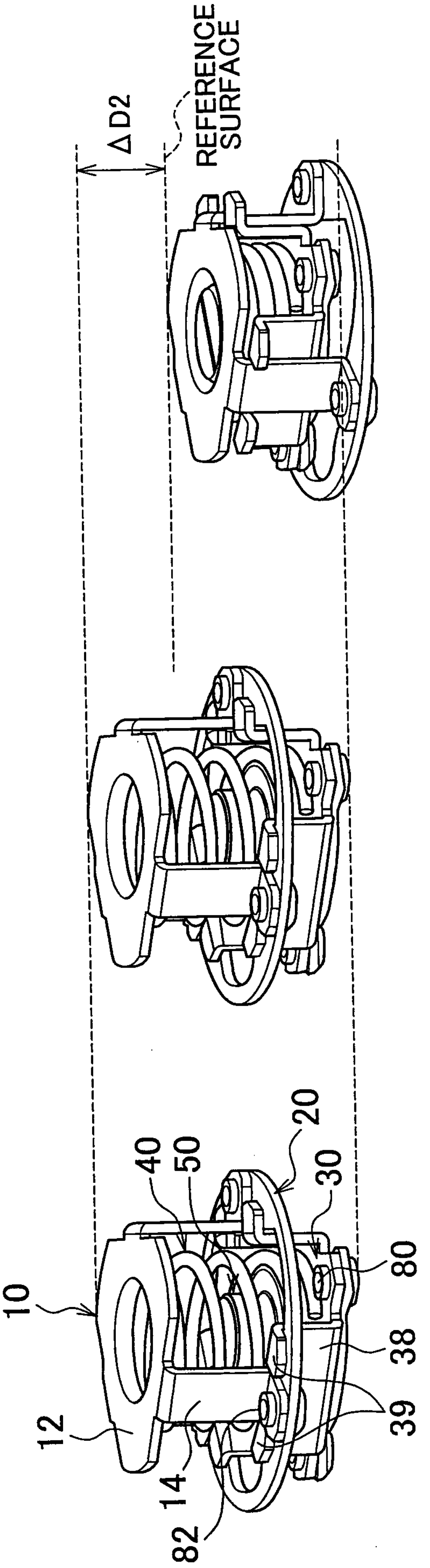
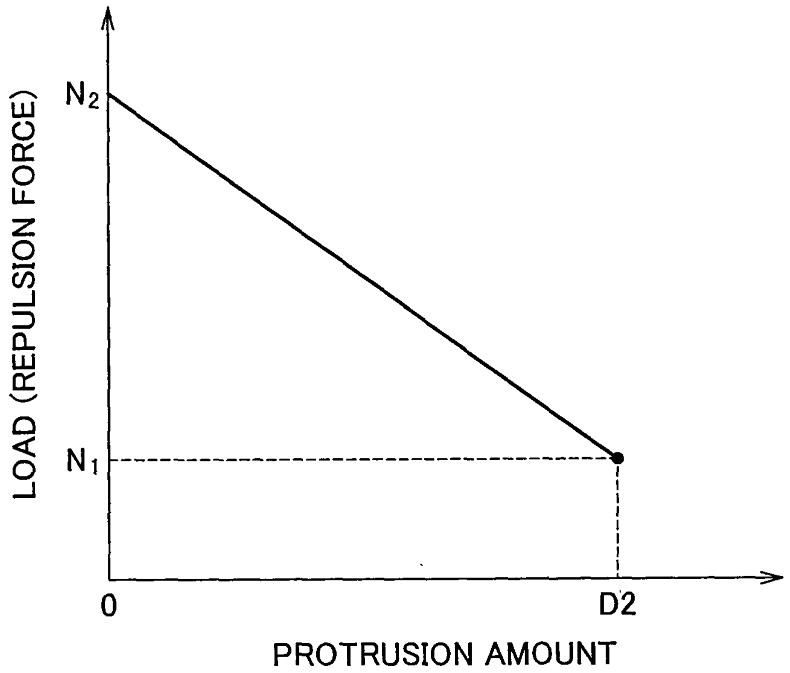


FIG.7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N2
N1
0
D2
PROTRUSION AMOUNT

FIG.8

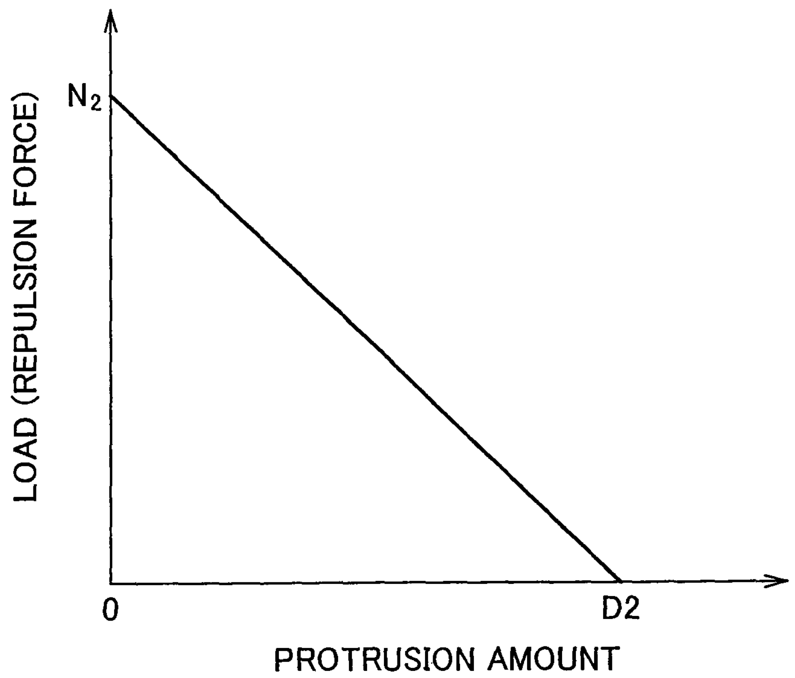
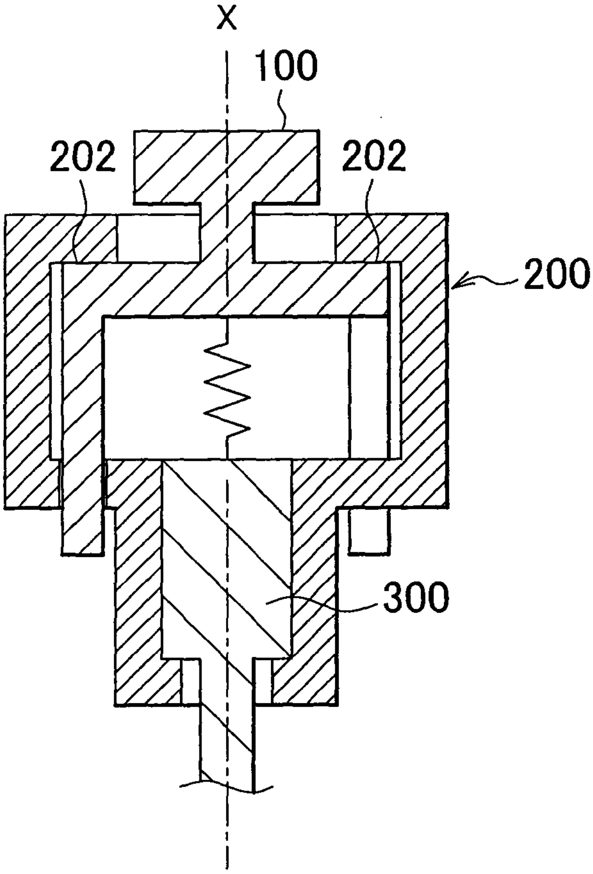

LOAD (REPULSION FORCE)
N2
0
D2
PROTRUSION AMOUNT

FIG. 9



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2001266704 A **[0002]**
- JP 2001189116 A **[0002]**
- JP 2006253063 A **[0002]**
- JP 2006277045 A **[0002]**
- JP 2008273313 A **[0002]**
- JP 2000315431 A **[0003]**