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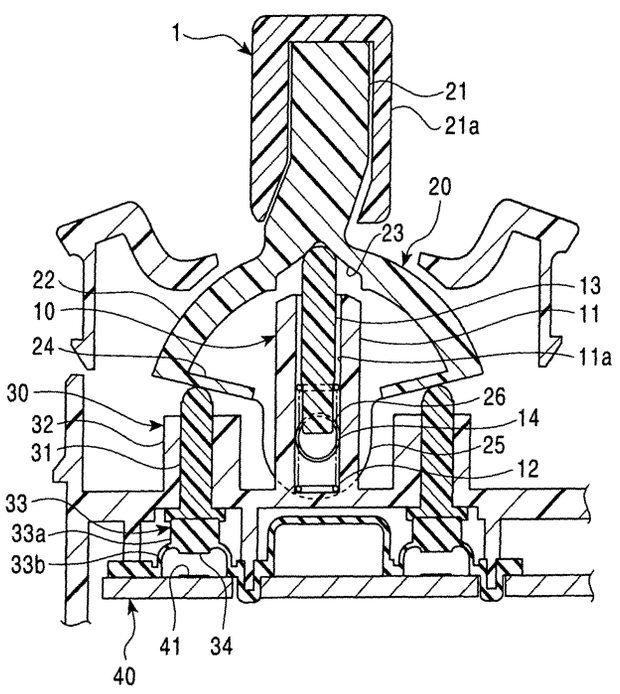
(54) Operating switch

(57) An operating switch includes a switch body (10) having a pressing unit which is biased upward by a resilient member; a tiltably-supported operating part (20) having a tapered guide (23) in the undersurface thereof such that the guide is in contact with the pressing unit (13); and contact units. Each contact unit includes a push-rod (31) which moves vertically when the operating part is tilted, an elastic member (33) which buckles when the push-rod presses against the member, and an elastic-member contact (34) which comes in contact with one of substrate-contacts (41). When the operating part is tilted, the pressing unit slides on the tapered guide while being pressed downward so as to produce a first type of operational feel, and one of the elastic members buckles while being pressed downward so as to produce a second type of operational feel, the two types being produced substantially at the same time.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an operating switch which can be turned on by tilting an operating part, and particularly, to an operating switch which imparts an operational feel to an operator when the operating part is being tilted.

2. Description of the Related Art

[0002] Operating switches generally used as, for example, vehicle-height adjustment switches or traction control switches are known. In such an operating switch, an operating part is provided which can be tilted in two directions so as to allow the switch to be turned on. Moreover, when an operator manipulates the operating part, the switch imparts an operational feel to the operator to let the operator know that the switch is being turned on or off.

[0003] Japanese Registered Utility Model No. 2519813 discloses a conventional switch which is capable of imparting an operational feel to an operator. In this operating switch, the undersurface of the operating part is provided with a tapered guide against which an activating rod is biased by a spring. As the operating part is tilted, the activating rod slides on the surface of the tapered guide. The tapered guide has two inclined planes which are each provided with a step in the middle of the plane. As the operating part is tilted and the activating rod slides on the tapered guide, the rod slides over one of the steps of the guide. Consequently, this imparts an operational feel to the operator. Furthermore, because the activating rod is pressed against the tapered guide by the resilient force of the spring, the operating part is forced to return to its initial position. In each of contact units of this operating switch, a thin rubber sheet is provided so that when the rubber sheet is pressed, the sheet generates a resilient force. This also contributes to the force for pulling back the operating part to the initial position.

[0004] According to another operating switch, the contact units, which come in contact with a substrate, are composed of rubber. When one of the rubber contact units is pressed, the contact unit buckles and generates deformation resistance. Consequently, this deformation resistance imparts an operational feel to the operator.

[0005] Operational feel produced by the pressing mechanism of the spring and by the buckling of the rubber component are distinctive from each other, each type imparting a different type of haptic feel from the other. Although such operational feel is enough to let an operator know the on/off state of the switch, due to many refinements which have been made in, for example, automobiles in recent years, an operating switch that imparts a new type of operational feel has been in great demand. In the operating switch disclosed in Japanese Registered Utility Model No. 2519813 described above, the contact units are each provided with a rubber sheet. Even though the rubber sheets produce resilient force by being pressed against and changing its shape, they cannot buckle, meaning that they do not produce an operational feel.

[0006] Furthermore, since a load is applied repeatedly against the spring and the rubber components by the tilting of the operating part, the spring and the rubber components can deteriorate easily. Thus, the spring and the rubber components may lose the ability to produce a desired resilient force. Moreover, the deterioration of the rubber components can lead to a loose connection between the contact units and the substrate.

SUMMARY OF THE INVENTION

[0007] Accordingly, it is an object of the present invention to provide an operating switch which imparts a new type of operational feel to an operator and in which a less amount of load is applied against components that generate resilient force.

[0008] An operating switch according to the present invention includes a switch body disposed on a substrate having substrate-contacts, a tiltable operating part supported by the switch body, and contact units which operate in conjunction with the tilting of the operating part and come into and out of contact with the substrate-contacts so that the switch is turned on and off. The switch body includes a pressing unit and a resilient member, the pressing unit being biased upward by the resilient member. The operating part has a tapered guide which is substantially V-shaped and disposed in the center of the undersurface of the operating part. The tapered guide is in contact with the pressing unit. Each of the contact units includes a push-rod which moves vertically when the operating part is tilted, an elastic member which is disposed below the push-rod and which buckles when the push-rod presses against the member, and an elastic-member contact which comes in contact with one of the substrate-contacts when the elastic member buckles. When the operating part is tilted, the pressing unit slides on the tapered guide while being pressed downward by the guide so as to produce a first type of operational feel, and one of the elastic members buckles while being pressed downward by the corresponding push-rod so as to produce a second type of operational feel. The first and second types of operational feel are produced substantially at the same time.

[0009] According to the present invention, since these types of operational feel are produced substantially at the same time, a combination of two types of operational feel is imparted. Furthermore, the structures and materials of the above components allow flexibility. In other words, by changing the structures and materials of the above components, for example, combinations of vari-

ous types of operational feel are possible.

[0010] Furthermore, since the resilient force for pulling back the operating part to the central position is applied both by the resilient member of the switch body and one of the elastic members of the contact units, a less amount of load is applied against the resilient member and the elastic members in comparison with conventional switches where an operating part is pulled back to the central position by a resilient force of a single component. This leads to a longer life cycle of the components, and moreover, contributes to size reduction of the components. Moreover, this also reduces the operating noise of the operating part.

[0011] Furthermore, each opposing surface of the substantially V-shaped tapered guide may bulge outward. Thus, when the operating part is tilted, the pressing unit may slide over one of the bulges of the guide while being pressed downward by the guide so as to produce the first type of operational feel.

[0012] Accordingly, an operational feel that is required in the operating switch can easily be produced.

[0013] Furthermore, each of the elastic members of the contact units may be provided with a main portion which is connected to the corresponding push-rod and has the corresponding elastic-member contact on the undersurface of the main portion, and thin deformable portions which extend from the bottom sections of the main portion and have a dome structure. Thus, the deformable portions buckle inward when the push-rod presses against and moves the main portion so that the elastic-member contact comes in contact with the corresponding substrate-contact.

[0014] Accordingly, the deformable portions are bent and buckle inward. The deformation resistance of the deformable portions is reduced as the portions buckle, thus producing an operational feel. Moreover, at the same time, one of the elastic-member contacts in the undersurface of the corresponding main portion comes in contact with the corresponding substrate-contact so that the substrate can be switched to a conductive state.

[0015] Furthermore, top portions of the push-rods may be in contact with an end portion of the operating part in an initial state of the switch.

[0016] Accordingly, one of the push-rods can be pressed by the operating part even when the operating part is tilted by a small angle. The push-rod causes the corresponding elastic member to be deformed, whereby the elastic member generates deformation resistance. This means that no matter which angle the operating part is tilted by, a combination of operational feel, i.e. the counterforce of the pressing unit against the tapered guide and the deformation resistance of one of the elastic members, is imparted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 is a cross-sectional view of an operating switch according to an embodiment of the present invention;

Fig. 2 is another cross-sectional view of the operating switch where an operating part of the switch is tilted at an angle of θ_1; and

Fig. 3 is another cross-sectional view of the operating switch where the operating part is tilted at an angle of θ_2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Embodiments of the present invention will now be described with reference to the drawings. Fig. 1 is a cross-sectional view of an operating switch 1 according to an embodiment of the present invention. Fig. 2 is another cross-sectional view of the switch 1 where an operating part 20 of the switch 1 is tilted at an angle of θ_1. Fig. 3 is another cross-sectional view of the switch 1 where the operating part 20 is tilted at an angle of θ_2. In this embodiment, the angles θ_1 and θ_2 will be used to describe the angles between which an operational feel is produced.

[0019] The operating switch 1 according to this embodiment is generally used for, for example, vehicle-height adjustment switches and traction control switches. The switch 1 is operated by tilting the operating part 20 in up/down motions or in left/right motions depending on how the switch 1 is installed. The switch 1 can thus be turned on according to the two directions. Referring to Fig. 1, the switch 1 includes a switch body 10 which is fixed to a substrate 40 disposed on an inner surface of, for example, a panel installed in a vehicle; the operating part 20 provided above the switch body 10 in a tiltable manner; and contact units 30 which operate in conjunction with the tilting of the operating part 20 to connect lines of a circuit on the substrate 40.

[0020] The switch body 10 functions as a base for the switch 1 and is provided with a rectangular pressing-mechanism 11 protruding upward in substantially the center of the body 10. The pressing mechanism 11 has a hole 11a extending substantially through its center. The hole 11a is circular in a cross-sectional view and includes a coil spring 12. The hole 11a further includes an activating rod 13 which has a semi-spherical top portion and is disposed above the coil spring 12. When the operating part 20 and the switch body 10 are assembled together, the activating rod 13 is pressed downward by a tapered guide 23 of the operating part 20, which will be described later. Accordingly, this downward pressure against the activating rod 13 causes the coil spring 12 below the rod 13 to be compressed. Thus, the resilient force of the coil spring 12 biases the rod 13 in the upward

direction. Two sides of the pressing-mechanism 11 are provided with cylindrical engagement-depressions 14 for supporting the operating part 20.

[0021] The operating part 20 mounted to the switch body 10 is provided with a knob 21 which is manipulated by an operator; a cover 22 which substantially has a circular-arc structure in a cross-sectional view and which substantially houses the switch body 10 positioned below the knob 21; and a mounting portion 25 which continuously extends from the cover 22 and is provided for mounting the operating part 20 to the switch body 10.

[0022] The knob 21 is rectangular and has a certain thickness. The structure of the knob 21 allows an operator to press against one side so that the operating part 20 can be tilted. Furthermore, the knob 21 is covered by a knob cover 21a composed of, for example, vinyl plastic.

[0023] The cover 22 not only functions as a protector for the internal structure of the switch body 10, but also as a presser for push-rods 31 provided in the contact units 30, which will be described later. For pressing against each push-rod 31, an end portion of the cover 22 is provided with a pressing surface 24. Furthermore, in substantially the center of the inner surface of the cover 22, the tapered guide 23 is provided. The tapered guide 23 is substantially V-shaped and comes in contact with the top portion of the activating rod 13. Each opposing surface of the substantially V-shaped tapered guide 23 bulges outward.

[0024] The mounting portion 25 has cylindrical engagement-protrusions 26 extending outward from the inner surfaces of the portion 25. The protrusions 26 engage with the depressions 14 such that the operating part 20 is supported by the switch body 10 in a tiltable manner.

[0025] Each contact unit 30 includes one of the push-rods 31 which moves downward by being pressed by the pressing surface 24 of the operating part 20; a rod-guide 32 for guiding the push-rod 31 in the vertical direction; an elastic member 33 which is disposed below the corresponding push-rod 31 and is thus pressed by the bottom portion of the push-rod 31 so that the member 33 moves downward while changing its shape; and a metallic contact 34 provided on the undersurface of the elastic member 33. The contact units 30 may be integrated with the switch body 10, or alternatively, may be provided as separate units.

[0026] The push-rods 31 have a cylindrical structure and have semi-spherical top portions. Moreover, the bottom portions of the push-rods 31 are disc-shaped. When the operating part 20 is in its initial state, that is, in a state where the part 20 is centrally positioned, each of the top portions of the push-rods 31 is in contact with the pressing surface 24.

[0027] Each rod-guide 32 has a hole which substantially has the same diameter as the corresponding push-rod 31. Accordingly, the rod-guide 32 is capable of guiding the push-rod 31 moving in the vertical direction. The pressing surface 24 of the operating part 20 comes in contact with the upper surface of each rod-guide 32 so that the tilting angle of the operating part 20 can be regulated.

[0028] Each elastic member 33 is composed of insulative rubber and is provided with a main portion 33a which is substantially cylindrical and is pressed against by the bottom portion of the corresponding push-rod 31, and thin deformable-portions 33b which extend from the bottom sections of the main portion 33a and have a dome structure. The upper surface of each main portion 33a is connected to the bottom portion of the corresponding push-rod 31, and the undersurface of each main portion 33a is provided with one of the contacts 34.

[0029] The operation of the operating switch 1 will now be described. Although the following description explains a case in which the operating part 20 is tilted toward the left side, the same applies for tilting the part 20 in the opposite direction except for the fact that the conductive state on the substrate 40 will be different. Furthermore, the same applies for an alternative case where the operating part 20 moves in up/down motions.

[0030] When an operating force is applied to the knob 21, the operating part 20 is tilted with respect to the protrusions 26 of the mounting portion 25. Fig. 2 illustrates a state where the operating part 20 is tilted at an angle of θ_1. Accordingly, the activating rod 13 slides on the tapered guide 23 by a distance proportional to the angle θ_1. The contact section between the tapered guide 23 and the activating rod 13 thus moves to a lower section of the guide 23. This causes the activating rod 13 to be pressed downwards and the coil spring 12 below the rod 13 to be compressed, thus generating a resilient force. Accordingly, the rod 13 functions as a pressing unit that applies pressure against the tapered guide 23. In other words, because the activating rod 13 is biased against the operating part 20 by the resilient force of the coil spring 12, when an operator releases his/her hand from the knob 21, the operating part 20 returns to the central position. Moreover, according to this resilient force of the coil spring 12, the rod 13 generates a counterforce against the tilting of the operating part 20 via the tapered guide 23. This counterforce advantageously imparts an operational feel when an operator tilts the operating part 20.

[0031] When the operating part 20 is tilted by θ_1, the top portion of one of the push-rods 31 is pressed by the pressing surface 24 of the cover 22, causing the push-rod 31 to move downward. At the same time, the corresponding main portion 33a connected to the bottom portion of the push-rod 31 moves downward. As the main portion 33a moves downwards, the corresponding deformable-portions 33b become deformed and thus generate a resilient force. When an operator releases his/her hand from the knob 21, the push-rod 31 biased upward against the pressing surface 24 by the resilient force of the deformable portions 33b forces the operating part 20 to return to the central position. Moreover,

when the main portion 33a is pressed, the deformable portions 33b generate deformation resistance. When an operator tilts the operating part 20, this resistance imparts an operational feel to the operator.

[0032] Accordingly, the resilient force for pulling back the operating part 20 to the central position is applied both by the coil spring 12 and the rubber deformable-portions 33b. In comparison with conventional switches where an operating part is pulled back to the central position by a resilient force of a single component, a less amount of load is applied against the coil spring 12 and the deformable portions 33b according to the present invention. Furthermore, this reduces the operating noise of the operating part 20.

[0033] As described above, since the top portions of the push-rods 31 are in contact with the pressing surface 24 in the initial state of the switch 1, the top portion of one of the push-rods 31 pressed by the pressing surface 24 moves downward immediately after the operating part 20 is tilted. Moreover, at the same time, the corresponding main portion 33a also moves downwards, whereby the corresponding deformable-portions 33b become deformed and thus generate deformation resistance. Consequently, a combination of two types of operational feel, i.e. the counterforce of the activating rod 13 against the tapered guide 23 imparted by the resilient force of the coil spring 12 and the deformation resistance generated by the deformable portions 33b, is imparted regardless of any angle by which the operating part 20 is tilted.

[0034] Referring to Fig. 3, the following is a description of a state in which the operating part 20 is tilted from angle θ_1 to angle θ_2 ($\theta_1 < \theta_2$). When the operating part 20 is tilted to angle θ_2, the activating rod 13 slides further down the tapered guide 23 by a distance proportional to the angle from θ_1 to θ_2. Here, the rod 13 slides over one of the bulges on the guide 23 to produce an operational feel. In detail, as the operating part 20 is being tilted, since the surfaces of the guide 23 bulge outward, the angle of inclination of the guide 23 contacting the rod 13 becomes smaller. This means that the counterforce of the rod 13 against the guide 23 becomes smaller in the direction of the inclination of the guide 23. Accordingly, from halfway through the tilting process of the operating part 20, a less amount of operational force is required, thereby imparting an operational feel to an operator.

[0035] Furthermore, as is similar to the tilting of the operating part 20 by θ_1, when an operator releases his/her hand from the knob 21, the activating rod 13 biased upward by the resilient force of the coil spring 12 forces the operating part 20 to return to the central position.

[0036] By tilting the operating part 20 by θ_2, the top portion of one of the push-rods 31 is pressed further by the pressing surface 24, causing the push-rod 31 to move down further. Accordingly, the corresponding main portion 33a is similarly moved downward, causing the deformable portions 33b to buckle toward the inner direction. The deformable portions 33b thus produce an operational feel. In detail, although the deformable portions 33b generate deformation resistance as the portions 33b are being deformed, when the main portion 33a moves downward to an extent that the deformable portions 33b cannot resist against the pressing force, the portions 33b buckle inward. The deformation resistance is reduced as the portions 33b buckle, thus producing an operational feel. Furthermore, as the main portion 33a moves downward, the corresponding contact 34 on the undersurface of the main portion 33a comes in contact with one of contacts 41 provided on the substrate 40, thus switching the substrate 40 to a conductive state.

[0037] As is similar to the tilting of the operating part 20 by θ_1, when an operator releases his/her hand from the knob 21, the push-rod 31 biased upward against the pressing surface 24 by the resilient force of the deformable portions 33b forces the operating part 20 to return to the central position.

[0038] The two kinds of operational feel produced by the tapered guide 23 and the activating rod 13 and by the deformable portions 33b are imparted substantially at the same time. The timing for producing these two kinds of operational feel can be controlled by adjusting, for example, the bulges on the tapered guide 23 or the top portion of the activating rod 13, the material and size of the coil spring 12, the material for the elastic members 33, or the thickness and structure of the deformable portions 33b.

[0039] Accordingly, by producing a combination of the two kinds substantially at the same time, a new type of operational feel can be imparted. Furthermore, modifications in, for example, the strength, the material, and the structure of the coil spring 12, or in the thickness, the structure, and the material of the deformable portions 33b are possible so as to allow combinations of various types of operational feel.

[0040] The technical scope of the present invention is not limited to the above embodiment, and modifications are permissible within the scope and spirit of the present invention. Although the tapered guide bulges outward and the activating rod slides over one of the bulges to produce an operational feel in the above embodiment, the present invention is not limited to such a structure. For example, the tapered guide may alternatively be provided with a small step on each opposing surface so that the activating rod may slide over a corresponding step to produce an operational feel. Accordingly, alternative structures are permissible.

[0041] Furthermore, although a coil spring is provided in the above embodiment, components for biasing the activating rod in the upward direction are not limited to coil springs and other resilient members that generate resilient force may be used alternatively. In that case, it is preferable that the alternative resilient members are composed of a material different from that of the elastic members so that different types of operational feel may be imparted.

[0042] Furthermore, the operating part does not necessarily need to have the structure described above. For example, instead of being provided with a knob, the operating part may alternatively have a seesaw-like structure.

Claims

1. An operating switch comprising:

a switch body disposed on a substrate having substrate-contacts, the switch body including a pressing unit and a resilient member, the pressing unit being biased upward by the resilient member;
a tiltable operating part supported by the switch body, the operating part having a tapered guide which is substantially V-shaped and disposed in the center of the undersurface of the operating part, the tapered guide being in contact with the pressing unit; and
contact units which operate in conjunction with the tilting of the operating part and come into and out of contact with the substrate-contacts so that the switch is turned on and off, each of the contact units including a push-rod which moves vertically when the operating part is tilted; an elastic member which is disposed below the push-rod and which buckles when the push-rod presses against the member; and an elastic-member contact which comes in contact with one of the substrate-contacts when the elastic member buckles, wherein
when the operating part is tilted, the pressing unit slides on the tapered guide while being pressed downward by the guide so as to produce a first type of operational feel, and one of the elastic members buckles while being pressed downward by the corresponding push-rod so as to produce a second type of operational feel, the first and second types of operational feel being produced substantially at the same time.

2. The operating switch according to Claim 1, wherein each opposing surface of the substantially V-shaped tapered guide bulges outward so that when the operating part is tilted, the pressing unit slides over one of the bulges of the guide while being pressed downward by the guide so as to produce the first type of operational feel.

3. The operating switch according to one of Claims 1 and 2, wherein each elastic member includes a main portion which is connected to the corresponding push-rod and has the corresponding elastic-member contact on the undersurface of the main portion, and thin deformable portions which extend from the bottom sections of the main portion and have a dome structure, the deformable portions buckling inward when the push-rod presses against and moves the main portion so that the elastic-member contact comes in contact with the corresponding substrate-contact.

4. The operating switch according to any one of Claims 1 to 3, wherein top portions of the push-rods are in contact with an end portion of the operating part in an initial state of the switch.

FIG. 1

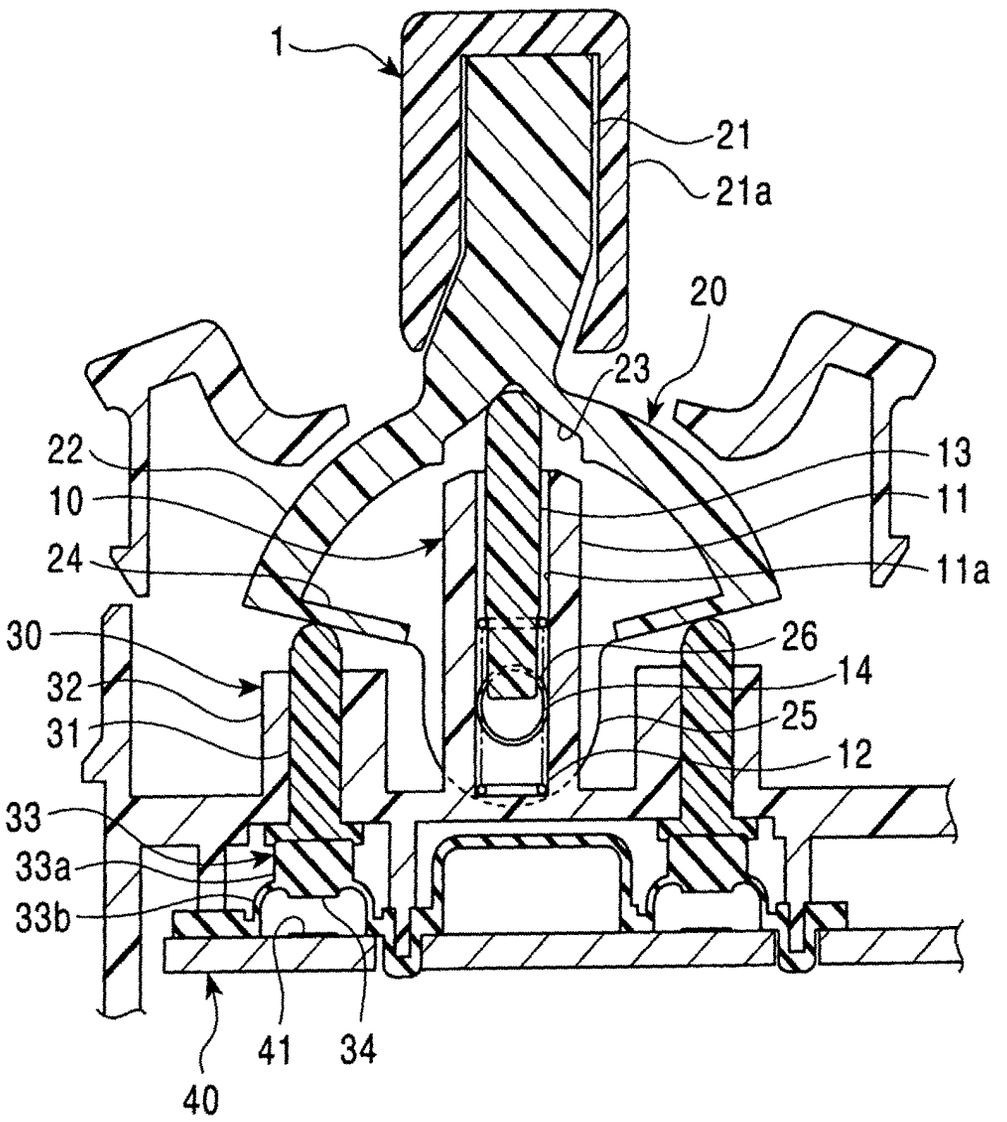
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FIG. 2

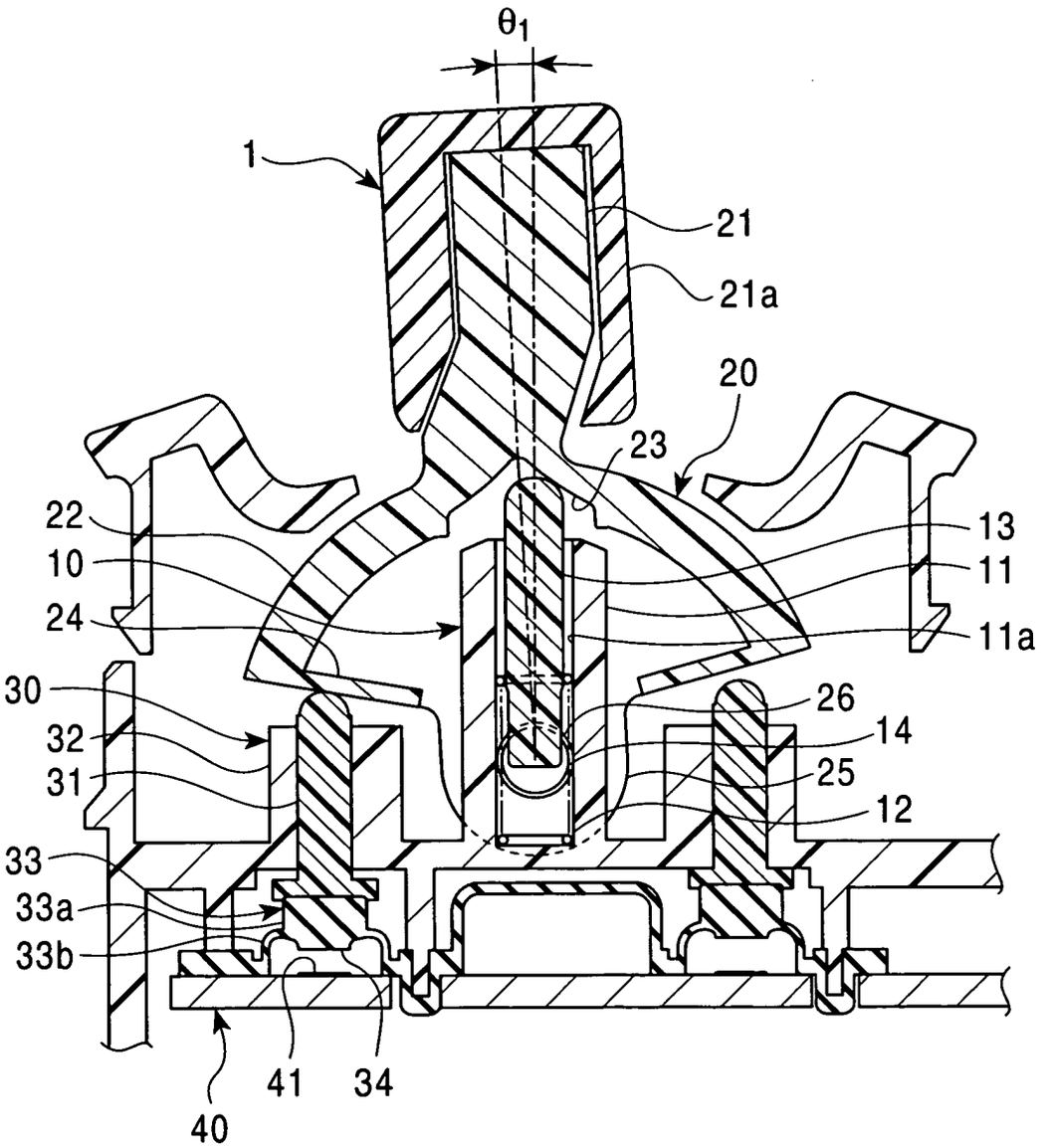
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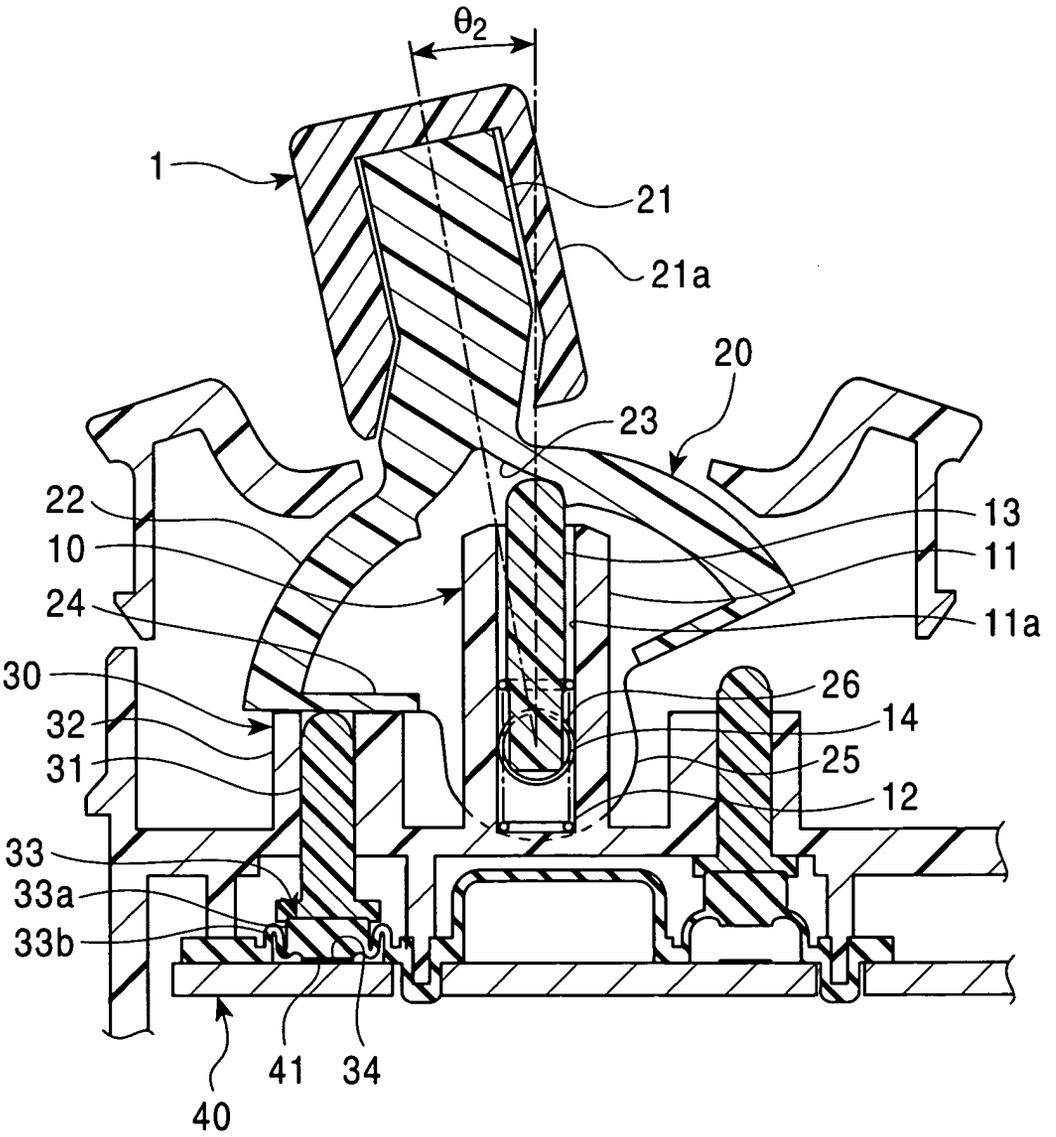
FIG. 3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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 00 9446

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 2002/060611 A1 (KUBOTA MINORU ET AL) 23 May 2002 (2002-05-23) * paragraph [0008]; figure 4 *	1-4	H01H23/16
A	US 5 115 108 A (ARAI KAZUYA ET AL) 19 May 1992 (1992-05-19) * abstract; figure 2a *	1-4	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 August 2004	Simonini, S

CATEGORY OF CITED DOCUMENTS

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03-08-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002060611 A1	23-05-2002	JP 2002157943 A	31-05-2002
		DE 10156437 A1	06-06-2002
US 5115108 A	19-05-1992	JP 3104931 U	30-10-1991
		JP 2792571 B2	03-09-1998
		JP 3236124 A	22-10-1991
		AU 627396 B2	20-08-1992
		AU 7083691 A	29-08-1991
		DE 4104572 A1	22-08-1991
		GB 2241383 A ,B	28-08-1991
		GB 2277199 A ,B	19-10-1994

EPO FORM P0459

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