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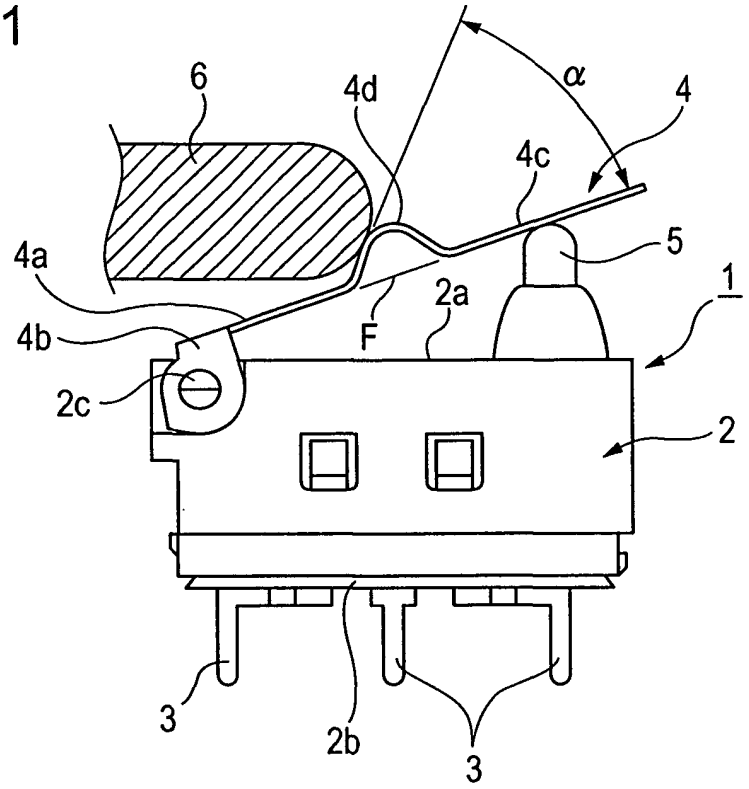
(54) Switch device

(57) An actuator (4) of a switch device (1) is formed with a protrusion (4d) which is a pressing portion which an external action member (6) can operate by pressing, such that moving the action member (6) in one direction parallel to one side wall (2a) of a casing (2) in a state with a supporting portion (4b) being rotatably supported by a turning supporting portion (2c) of the casing (2) causes the protrusion (4d) to be pressed in the direction toward the one side wall (2a) such that the actuator (4) can turn on the supporting portion (4b) as a point of support, wherein the amount of turning of the protrusion (4d) at the time of turning the actuator (4) downwards by moving the action member (6) in the one direction parallel to the one side wall (2a) is greater than the amount of movement of the action member (6) in the one direction.

FIG. 1



EP 1 734 548 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a switch device, and more particularly relates to a switch device wherein an external acting member is moved in one direction whereby an actuator turns in a direction orthogonal to the direction of movement of the acting member, such that a switch circuit is switched.

2. Description of the Related Art

[0002] A known switch device, disclosed in Japanese Unexamined Patent Application Publication No. 2004-311091, will be described with reference to Figs. 6 and 7. The known switch device 20 has provided thereto a casing 21, with an unshown switch circuit being formed within the casing 21. The casing 21 has multiple terminals 21, which are connected to the internal switch circuit, extending downwards in the drawing.

[0003] Also, an actuator 23 is formed of a metal plate, and is integrally formed with the casing 21 by an attachment leg 24 being fixed to the casing 21 by a press or the like.

[0004] The actuator 23 is formed with the attachment leg 24 being bent an a generally right angle to a horizontal state as shown in the drawing so as to form a supporting portion 25, and with a portion closer to the tip side of the supporting portion 25 being bent in the opposite direction from that of the attachment leg 24 at an angle A (generally 35°), thereby forming a raised portion 26.

[0005] Further closer to the tip side of the raised portion 26 is formed a contact portion formation portion 27, which is generally parallel to the supporting portion 25.

[0006] An action member contact portion 28 is formed on the front side of the contact portion formation portion 27, at a portion extended from the inclined raised portion 26.

[0007] Also, a switch operating unit 30 is formed below the contact portion formation portion 27 which protrudes upwards with a predetermined height, and upon this switch operating unit 30 being pressed by the contact portion formation portion 27, the switch operating unit 30 descends, whereby the switch circuit (not shown) within the casing 21 is switched.

[0008] Also, an action member 31 which is movably operable in the direction of the arrow B is disposed above the supporting portion 25 of the actuator 23 generally in the horizontal state outside of the switch device 20.

[0009] With such a known switch device 20, in the initial state shown in Fig. 6, the switch operating unit 30 is at a predetermined height, with the supporting portion 25 of the actuator 23 and the contact portion formation portion 27 being in a generally horizontal state.

[0010] In such an initial state, upon the action member 31 being operated by moving in the direction of the arrow B, which is the right direction in the drawing, the raised portion 26 of the actuator 23 which is inclined at a generally 35 degree angle is pressed and descends downwards. The amount of descent of the raised portion 26 at this time is smaller than the amount of movement of the action member 31 in the direction of the arrow B.

[0011] Due to the raised portion 26 descending, the supporting portion 25 in the generally horizontal state"is elastically deformed downwards, such that the contact portion formation portion 27 turns in the direction of the arrow C, as shown in Fig. 7.

[0012] Accordingly, the switch operating unit 30 is pressed into the casing 21 by the contact portion formation portion 27, thereby switching the internal switch circuit of the casing from an off state to an on state.

[0013] Also, moving the action member 31 in the opposite direction from that of the arrow B in the state wherein the switch operating unit 30 is pressed in causes the pressing of the switch operating unit 30 to be released, and the actuator 23 returns to the initial state shown in Fig. 6 under its own elasticity.

[0014] Accordingly, the internal switch circuit is turned off.

[0015] However, the actuator 23 of the known switch device 20 is formed having an angle A (generally 35 degrees) at the raised portion 26, so the amount of turning of the raised portion 26 is smaller than the amount of movement of the action member 31 in the direction of the arrow B.

[0016] Accordingly, there has been a problem in that the a great amount of movement is required of the action member 31 in the direction of the arrow B at the time of switching operation for pressing the switch operating unit 30 into the casing 21.

[0017] Such a great amount of movement of the action member 31 reduces the pressing speed of the switch operating unit 30, leading to the concern that the response speed at the time of switching operation may be slow.

[0018] Also, the actuator 23 is configured of the attachment leg 24, the supporting portion 25 wherein the attachment leg 24 has been bent at a generally right angle to a horizontal state, the raised portion 26 formed with the tip side of the supporting portion 25 bent upwards at an angle A (e.g., 35 degrees), the contact portion formation portion 27 formed toward the tip side of the raised portion 26, and the action member contact portion 28 formed protruding at the front side of the contact portion formation portion 27. This has led to the problem that fabricating the actuator 23 becomes complicated.

SUMMARY OF THE INVENTION

[0019] The present invention has been made to solve the above-described problems, and accordingly it is an object thereof to provide a switching device using an actuator which has a simple structure and which is easily

manufactured, while enabling improvement in response speed at the time of switching operations, using an action member with small movement amount.

[0020] According to a first aspect of the present invention, a switch device comprises: a casing with a switch circuit formed internally; an actuator with a supporting portion formed on one end side and the other end side being formed as a free end; and a switch operating unit externally protruding from one side wall of the casing to a predetermined height, so as to be capable of switching the switch circuit by being pressed into the casing by turning of the actuator; wherein the actuator is formed with a pressing portion which an external action member can operate by pressing, such that moving the action member in one direction parallel to the one side wall in a state with the supporting portion being rotatably supported by the casing causes the pressing portion to be pressed in the direction toward the one side wall such that the actuator can turn on the supporting portion as a point of support, and wherein the amount of turning of the pressing portion at the time of turning the actuator by moving the action member in the one direction is greater than the amount of movement of the action member in the one direction.

[0021] The actuator may be formed of a plate member having elasticity, and the pressing portion formed of a protrusion formed protruding in the direction away from one side wall of the casing in an inverse V-shape between the one end side and the other end side.

[0022] The angle of protrusion (α) of the protrusion as to the one end side may be formed to be 45 degrees or greater.

[0023] According to a second aspect of the present invention, a switch device comprises: a casing with a switch circuit formed internally; an actuator with a supporting portion formed on one end side and the other end side being formed as a free end; and a switch operating unit externally protruding from one side wall of the casing to a predetermined height, so as to be capable of switching the switch circuit by being pressed into the casing by turning of the actuator; wherein the actuator is formed with a pressing portion which an external action member can operate by pressing, such that moving the action member in one direction parallel to the one side wall in a state with the supporting portion being rotatably supported by the casing causes the pressing portion to be pressed in the direction toward the one side wall such that the actuator can turn on the supporting portion as a point of support, with a pressing member for elastically pressing the other end side in the direction away from the one side wall being provided to the other end side of the actuator; and wherein, upon returning the operating member from the state in which the operating member has been moved in the one direction to press the pressing portion, to the other direction in the opposite direction from the one direction, the actuator turns in the direction away from the one side wall due to the pressing force of the elastic member.

[0024] The actuator may be formed of a plate member having elasticity, and the pressing member formed by cutting and bending a part of the other end side of the actuator in a cantilever state toward the one side wall of the casing.

[0025] The switch device may further comprise a contact member with which the free end of the pressing member is capable of coming into contact, being disposed on one side wall of the casing, and upon the pressing portion being pressed in the direction toward the one side wall by the action member, movement of the free end of the pressing member is restricted by the contact member.

[0026] In the event of moving the action member in the one direction so as to press the pressing portion in a state wherein the free end of the pressing member is in contact with the contact member, the pressing member may be inverted such that the pressing force as to the other end side of the actuator becomes weak, with the other end side elastically deforming in the direction of pressing the switch operating unit into the casing.

[0027] The actuator of the switch device according to the first aspect of the present invention is formed with a pressing portion which an external action member can operate by pressing, such that moving the action member in one direction parallel to the one side wall in a state with the supporting portion being rotatably supported by the casing causes the pressing portion to be pressed in the direction toward the one side wall such that the actuator can turn on the supporting portion as a point of support, wherein the amount of turning of the pressing portion at the time of turning the actuator by moving the action member in the one direction is greater than the amount of movement of the action member in the one direction, so the pressing portion can be turned a great amount with a small movement amount of the action member, thereby speedily pressing down the switch operating unit. Accordingly, response speed of switching the switch circuit within the casing can be improved.

[0028] Forming the actuator of a plate member having elasticity, and the pressing portion of a protrusion formed protruding in the direction away from one side wall of the casing in an inverse V-shape between the one end side and the other end side, enables the protrusion can be easily formed by pressing or the like, and manufacturing of the actuator is easy.

[0029] Also, forming the angle of protrusion (α) of the protrusion as to the one end side is formed to be 45 degrees or greater, allows the amount of turning of the protrusion, which is the pressing portion, to be made greater than the amount of movement of the action member in a sure manner. Accordingly, the response speed of switching of the switch circuit can be improved.

[0030] Also, the actuator according to the second aspect of the present invention is formed with a pressing portion which an external action member can operate by pressing, such that moving the action member in one direction parallel to the one side wall in a state with the supporting portion being rotatably supported by the cas-

ing causes the pressing portion to be pressed in the direction toward the one side wall such that the actuator can turn on the supporting portion as a point of support, with a pressing member for elastically pressing the other end side in the direction away from the one side wall being provided to the other end side of the actuator; wherein, upon returning the operating member from the state in which the operating member has been moved in the one direction to press the pressing portion, to the other direction in the opposite direction from the one direction, the actuator turns in the direction away from the one side wall due to the pressing force of the elastic member, so the actuator can be returned to the initial state in a sure manner, even in the event that the returning force of the switch pressing portion is weak.

[0031] Forming the actuator of a plate member having elasticity, and the pressing member by cutting and bending a part of the other end side of the actuator in a cantilever state toward the one side wall of the casing, enables the pressing member can be integrally formed with the actuator, facilitating assembly.

[0032] Upon the pressing portion being pressed in the direction toward the one side wall by the action member, the contact member with which the free end of the pressing member is capable of coming into contact that has been provided on one side wall of the casing restricts and movement of the free end of the pressing member, so the pressing force of the pressing member is increased by bringing the free end into contact with the contact member, and the actuator can be returned to the initial state in a sure manner.

[0033] In the event of moving the action member in the one direction so as to press the pressing portion in a state wherein the free end of the pressing member is in contact with the contact member, the pressing member is inverted and the pressing force as to the other end side of the actuator becomes weak, with the other end side elastically deforming in the direction of pressing the switch operating unit into the casing, so the switch operating portion can be pressed into the casing even faster, thereby improving the response speed of switching the switch circuit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

Fig. 1 is a side view of a switch device according to a first embodiment of the present invention;
Fig. 2 is a side view for explaining operations of the switch device shown in Fig. 1;
Fig. 3 is a side view of a switch device according to a second embodiment of the present invention;
Fig. 4 is a side view for explaining operations of the switch device shown in Fig. 3;
Fig. 5 is a side view for explaining operations of the switch device shown in Fig. 3;
Fig. 6 is a side view for explaining a known switch device; and
Fig. 7 is a side view for explaining operations of the switch device shown in Fig. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0035] The following is a description of first and second embodiments of the switch device of the present invention with reference to the drawings. Fig. 1 is a side view of a first embodiment of the present invention before switching operation, Fig. 2 is a side view for explaining switching operations of the switch device shown in Fig. 1, Fig. 3 is a side view of a second embodiment of the present invention before switching operation, and Figs. 4 and 5 are side views for explaining switching operations of Fig. 3.

[0036] First, as shown in Fig. 1, a switch device 1 according to the first embodiment is provided with a casing 2 formed of an insulating material such as a resin material or the like, with a switch circuit (not shown) formed within. This casing 2 has one side wall 2a formed on the upper portion in the drawing, and the other side wall 2b formed on the lower portion in the drawing.

[0037] Multiple terminals 3 connected to the internal switch circuit are formed extending from the other side wall 2b of the casing 2.

[0038] Also, a turning supporting portion 2c is formed at the left side of the one side wall 2a of the casing, for turnably supporting a later-described actuator 4.

[0039] Also, the turning supporting portion 2c turnably supports an actuator 4 formed of a plate member having elasticity, with a supporting portion 4b being formed on one end side 4a of the actuator 4 to the left side in the drawing, such that the supporting portion 4b is supported in cantilever fashion at the turning supporting portion 2c. An other end side 4c of the actuator 4 at the right side in the drawing is formed as a free end. The one end side 4a and the other end side 4c are formed so as to be on the same plane.

[0040] Also, with the actuator 4, a protrusion 4d which is a pressing portion is formed between the one end side 4a and the other end side 4c, with the protrusion 4d protruding in the direction away from the one side wall 2a of the casing 2, which is the upwards direction in the drawing, in an inverse V shape.

[0041] The protruding angle α of the protrusion 4d is formed at an angle of 45 degrees of more as to an exponential line F of the one end side 4a.

[0042] Also, a switch operating unit 5 which externally protrudes from the casing 2 to a predetermined height due to being elastically pressed is formed on the one side wall 2a of the casing 2, at the right side in the drawing, so that upon this switch operating unit 5 being pressed into the casing 2, the switch circuit within the casing 2 is switched.

[0043] Also, the strength of the actuator 4 is such that the switch operating unit 5 can be pressed even in the event that the pressing force elastically pressing the

switch operating unit 5 out from the casing 2 is strong.

[0044] Accordingly, the strength thereof is such that the actuator 4 does not deform when the actuator is turned and the switch operating unit 5 is pressed down.

[0045] Also, an action member 6 is disposed above the switch device 1 according to the present invention toward the upper left in the drawing. One example of application of this switch device is in a seatbelt device provided in an automobile or the like. In such an application, the action member 6 can be supported by a tongue or the like which is engaged with a buckle of the seatbelt, thereby allowing the seatbelt to be worn by a passenger of the automobile.

[0046] The action member 6 is movably operable in the direction of the arrow D parallel to the one side wall 2a of the casing 2, and the action member 6 in the initial state shown in Fig. 1 is in a state in contact with the slanting face having an inclination angle α (45 degrees or more) of the protrusion 4d of the actuator 4 of which the tip is in the raised position.

[0047] As for the switching operation of the switch device 1 according to the first embodiment of the present invention configured thus, moving operations of the action member 6 in the one direction in the direction of the arrow D causes the tip of the action member 6 to press the protrusion 4d in the direction toward the one side wall 2a.

[0048] The actuator 4 then turns in the direction of the arrow E with the supporting portion 4b as the point of support, so that the other end side 4c presses the switch operating unit 5 into the casing 2.

[0049] Accordingly, the switch circuit (not shown) within the casing 2 is switched from the off state to the on state.

[0050] Also, as shown in Fig. 2, returning the action member 6, which is in the state of pressing the protrusion 4d downwards, in the direction reverse to that of the arrow D, the switch operating unit 5 which had been pressed in the direction of the arrow E by the actuator 4 rises, and the switch circuit within the casing 2 switches from the on state to the off state.

[0051] The switch operating unit 5 rises to the initial state, and the actuator 4 also returns to the initial state shown in Fig. 1.

[0052] With the switch device 1 according to the first embodiment thus configured, the protrusion angle α of the protrusion 4d which is the pressing portion is formed at 45 degrees or greater, so the amount of turning of the protrusion 4d which is the pressing portion due to the turning of the actuator 4 upon moving the action member 6 in the one direction of the arrow D is greater than the amount of moment of the action member 6 in the one direction of the arrow D.

[0053] Accordingly, even in the event that the amount of movement of the action member 6 in the one direction of the arrow D is small, the amount of turning of the actuator 4 in the direction of the arrow E can be made to be great, thereby improving the response speed of switching of the switch circuit within the casing 2.

[0054] With the switch device 1 according to the first embodiment thus configured, the actuator 4 can be turned a great amount with a small movement amount of the action member 6, thereby increasing the pressing speed of the switch operating unit 5 and improving the response speed at the time of switching operations.

[0055] Also, the supporting portion 4b is formed on the one end side 4a of the actuator 4, and also the protrusion 4d which is the pressing portion in an inverse V-shape is formed between the one end side 4a and the other end side 4c, so the structure of the actuator 4 is simple, and manufacturing by pressing or the like is easy.

[0056] Now, while description has been made with the first embodiment of the present invention that the actuator 4 returns to the initial state by the upwards pressing force of the switch operating unit 5, an arrangement may be made wherein a torsion coil spring (not shown) is disposed on the supporting portion 4b side, so as to press the actuator 4 upwards.

[0057] Also, the action member 6 has been described as having a tip portion in a rounded shape, but the tip portion may be squared rather than in a rounded shape.

[0058] Now, a switch device 11 according to a second embodiment of the present invention will be described with reference to Figs. 3 through 5. Components which are the same as those in the first embodiment will be denoted with the same numerals as with the first embodiment, and detailed description thereof will be omitted.

[0059] First, as shown in Fig. 3, the switch device 11 according to the second embodiment of the present invention has an actuator 12 formed with a supporting portion 12b on one end side 12a to the left, and the supporting portion 12b is supported in cantilever fashion by the turning supporting portion 2c of the casing 2, with the other end side 12c to the right in the drawing being formed a free end.

[0060] Also, as with the first embodiment, the one end side 12a and the other end side 12c are formed so as to be on the same plane.

[0061] Also, with the actuator 12, a protrusion 12d which is a pressing portion is formed between the one end side 12a and the other end side 12c, with this protrusion 12d being formed protruding in the direction away from the one side wall 2a of the casing 2, which is the upwards direction in the drawing, in an inverse V shape.

[0062] The protruding angle α of the protrusion 12d is formed at an angle of 45 degrees of more as to an exponential line F of the one end side 12a.

[0063] Also, the actuator 12 is formed of a plate member having elasticity, for example, metal plate such as a phosphor bronze plate or a stainless steel plate or the like, with the other end side 12c being integrally formed with a pressing member 13 which presses the other end side 12c in the direction away from the one side wall 2a (upwards in the drawing).

[0064] The pressing member 13 is formed by cutting and bending a part of the other end side 12c of the ac-

tuator 12 in a cantilever state toward the one side wall 2a of the casing.

[0065] Also, a contact member 14 with which the free end of the cantilever pressing member 13 is capable of coming into contact is fixed to the one side wall 2a of the casing 2, and upon the protrusion 12d which is the pressing portion being pressed downward in the drawing in the direction toward the one side wall 2a by the action member 6 being moved in the direction of the arrow D, movement of the free end of the pressing member 13 is restricted by a stopper 14a of the contact member 14.

[0066] As for the switching operations of the switch device 11 according to the second embodiment of the present invention having such a configuration, upon the action member 6 being operated by moving in the one direction of the arrow D direction, and the tip of the action member 6 pressing the protrusion 12d, the protrusion 12d is pressed downward in the direction toward the one side wall 2a.

[0067] The actuator 12 then turns at the other end side 12c in the direction of the arrow G with the supporting portion 12b as the point of support, and the switch operating unit 5 is pressed downwards into the casing 2.

[0068] At the same time, as shown in Fig. 4, the movement of the free end of the pressing member 13 is restricted by the stopper 14 of the contact member 12.

[0069] The actuator 4 here is elastically pressed in the direction where the other end side 12c attempts to move away from the one side wall 2a due to the pressing member 13, but the pressing force of the pressing member 13 is not so great as to elastically deform the other end side 12c upwards.

[0070] Next, upon further moving the action member 6 in the one direction of the arrow D from the state shown in Fig. 4, the protrusion 12d of the actuator 12 is further pressed downward, as shown in Fig. 5.

[0071] Accordingly, the plate-shaped pressing member 13 is inverted upwards, and the pressing force which had been pressing the other end side 12c upwards rapidly weakens.

[0072] The other end side 12c of the actuator 12 is subjected to pressing force in the direction for pressing the switch operating portion 5 further into the casing 2, so that the switch operating unit 5 is further pressed into the casing 2.

[0073] Also, upon returning the action member 6 in the reverse direction to the arrow D from the state wherein the pressing member 13 is inverted as shown in Fig. 5 to the initial state, the inverted pressing member 13 returns to the elastically deformed state shown in Fig. 4, whereby the other end side 12c of the actuator 12 is elastically pressed upwards.

[0074] Accordingly, the other end side 12c of the actuator 12 is pressed upwards by the pressing force of the pressing member 13, and accordingly automatically returns to the initial state such as shown in Fig. 3.

[0075] With the switch device 11 according to the second embodiment of the present invention configured thus, moving the action member 6 in the one direction of the arrow D inverts the pressing member 13 so that the switch operating unit 5 can be speedily pressed in.

[0076] Also, returning the action member 6 in the opposite direction as the arrow D in the state that the protrusion 12d has been pressed and the pressing member 13 inverted causes the pressing member 13 to return to the state shown in Fig. 4, so the actuator 12 can be speedily returned to the initial state.

[0077] Accordingly, the second embodiment of the present invention can further improve the response speed at the time of switching operations in comparison with the first embodiment.

[0078] Note that while the second embodiment of the present invention has been described with the pressing member 13 being formed by integrally formed with the actuator 12 by cutting and bending the other end side 12c of the actuator 12, and arrangement may be made wherein a pressing member (not shown) such as a coil spring or the like is provided as a separate member from the actuator 12 and disposed between the one side wall 23a of the casing 2 and the actuator 12.

[0079] Also, while description has been made that the free end of the pressing member 13 is brought into contact with the stopper 14 of the contact member 14, an arrangement may be made wherein the contact member 14 is not provided, and the free end of the pressing member 13 is directly elastically pressed against the one side wall 2a of the casing 2.

Claims

1. A switch device comprising:

a casing with a switch circuit formed internally;
an actuator with a supporting portion formed on one end side and the other end side being formed as a free end; and
a switch operating unit externally protruding from one side wall of the casing to a predetermined height, so as to be capable of switching the switch circuit by being pressed into the casing by turning of the actuator;

wherein the actuator is formed with a pressing portion which an external action member can operate by pressing, such that moving the action member in one direction parallel to the one side wall in a state with the supporting portion being rotatably supported by the casing causes the pressing portion to be pressed in the direction toward the one side wall such that the actuator can turn on the supporting portion as a point of support;
and wherein the amount of turning of the pressing portion at the time of turning the actuator by moving the action member in the one direction is greater than the amount of movement of the action member

in the one direction.

2. The switch device according to Claim 1, wherein the actuator is formed of a plate member having elasticity, and
wherein the pressing portion is formed of a protrusion formed protruding in the direction away from one side wall of the casing in an inverse V-shape between the one end side and the other end side.

3. The switch device according to Claim 2, wherein the angle of protrusion (α) of the protrusion as to the one end side is formed to be 45 degrees or greater.

4. A switch device comprising:

a casing with a switch circuit formed internally;
an actuator with a supporting portion formed on one end side and the other end side being formed as a free end; and
a switch operating unit externally protruding from one side wall of the casing to a predetermined height, so as to be capable of switching the switch circuit by being pressed into the casing by turning of the actuator;

wherein the actuator is formed with a pressing portion which an external action member can operate by pressing, such that moving the action member in one direction parallel to the one side wall in a state with the supporting portion being rotatably supported by the casing causes the pressing portion to be pressed in the direction toward the one side wall such that the actuator can turn on the supporting portion as a point of support, with a pressing member for elastically pressing the other end side in the direction away from the one side wall being provided to the other end side of the actuator;
and wherein, upon returning the operating member from the state in which the operating member has been moved in the one direction to press the pressing portion, to the other direction in the opposite direction from the one direction, the actuator turns in the direction away from the one side wall due to the pressing force of the elastic member.

5. The switch device according to Claim 4, wherein the actuator is formed of a plate member having elasticity, and
wherein the pressing member is formed by cutting and bending a part of the other end side of the actuator in a cantilever state toward the one side wall of the casing.

6. The switch device according to Claim 4 or 5, wherein a contact member with which the free end of the pressing member is capable of coming into contact is disposed on one side wall of the casing, and upon the pressing portion being pressed in the direction toward the one side wall by the action member, movement of the free end of the pressing member is restricted by the contact member.

7. The switch device according to any of Claims 4 to 6, wherein, in the event of moving the action member in the one direction so as to press the pressing portion in a state
wherein the free end of the pressing member is in contact with the contact member, the pressing member is inverted and the pressing force as to the other end side of the actuator becomes weak, with the other end side elastically deforming in the direction of pressing the switch operating unit into the casing.

FIG. 1

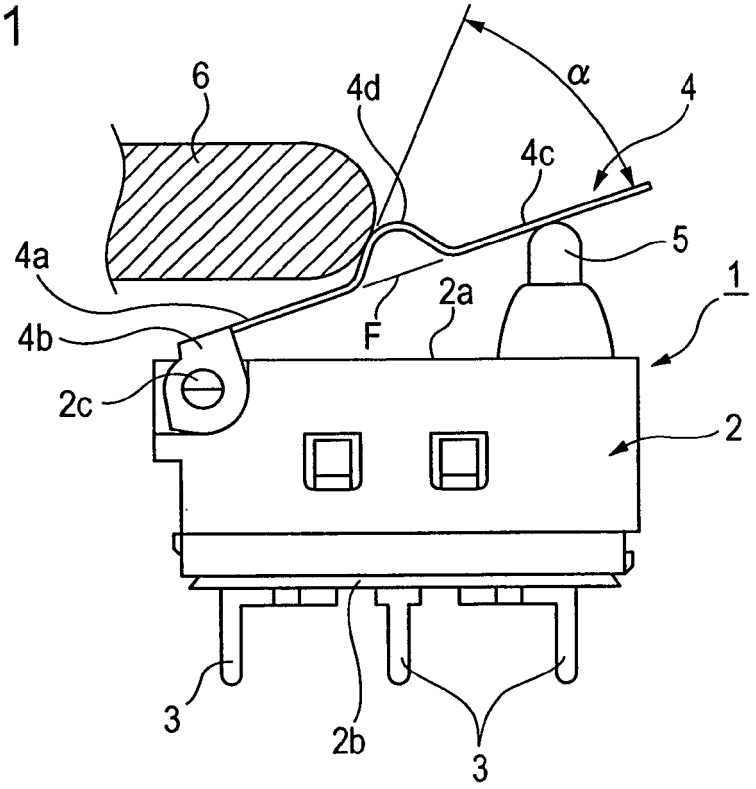


FIG. 2

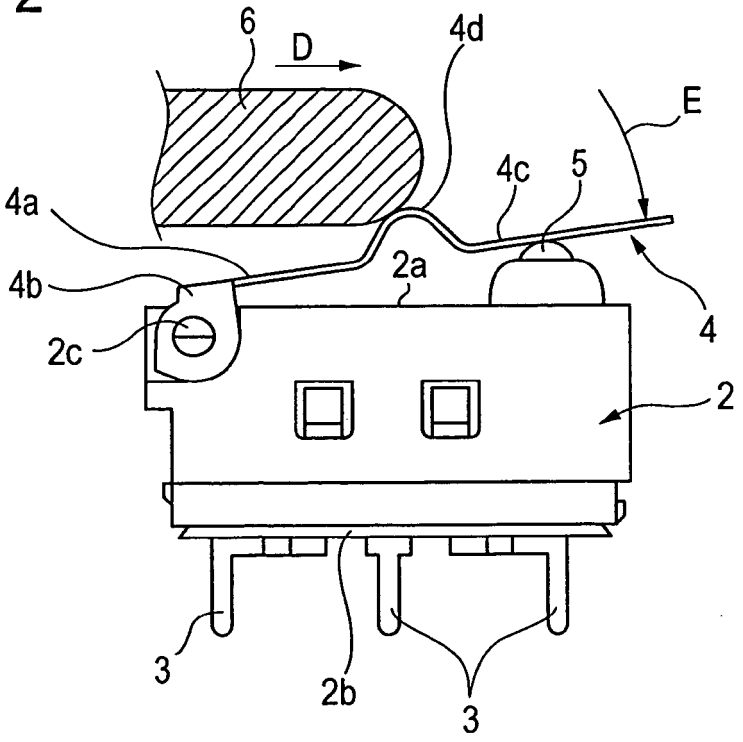


FIG. 3

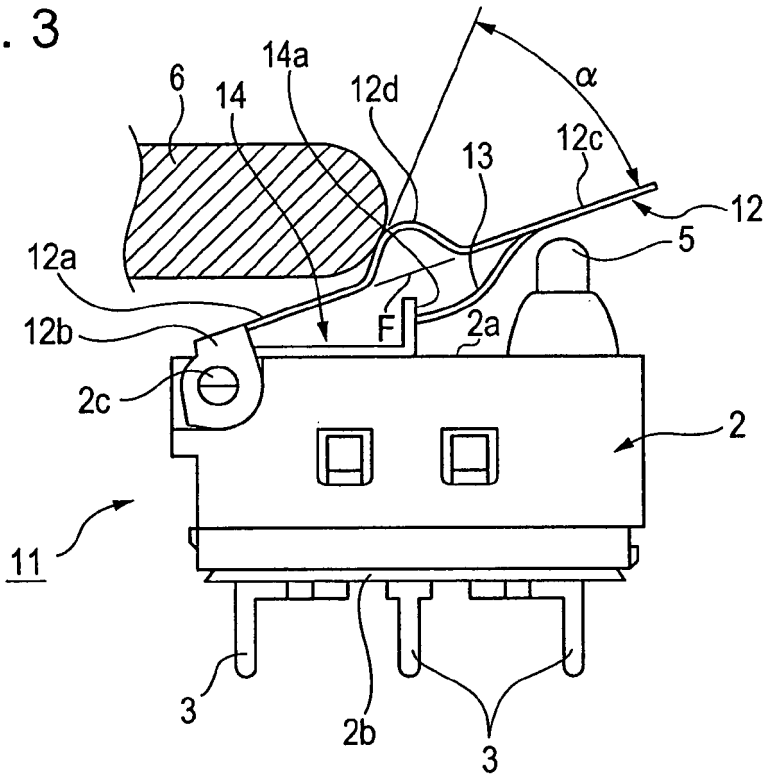
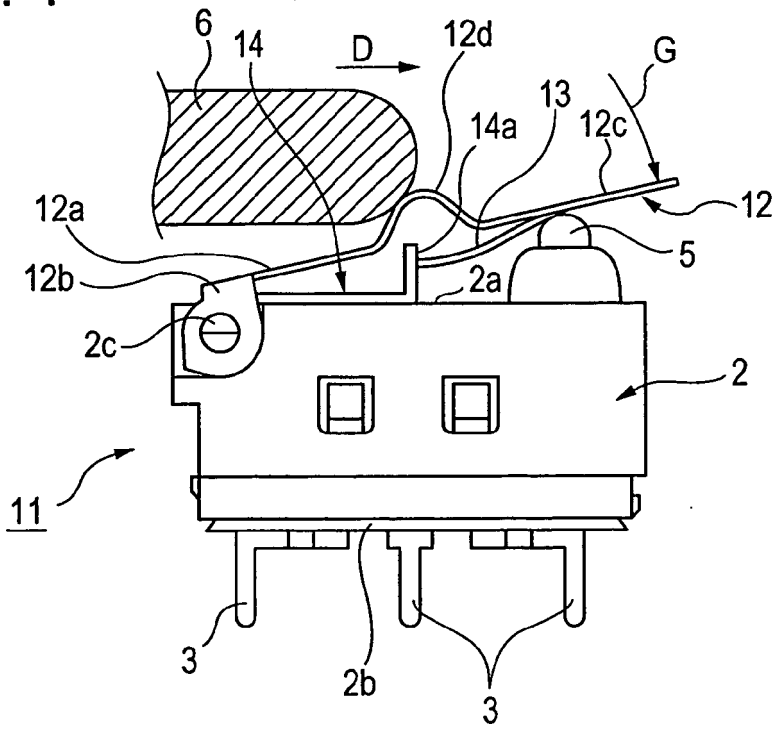

6
14
14a
12d
α
12c
13
12
5
12a
12b
F
2a
2c
2
11
3
2b
3

FIG. 4


6
14
D
12d
G
13
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12c
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12a
5
12b
2a
2c
2
11
3
2b
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FIG. 5

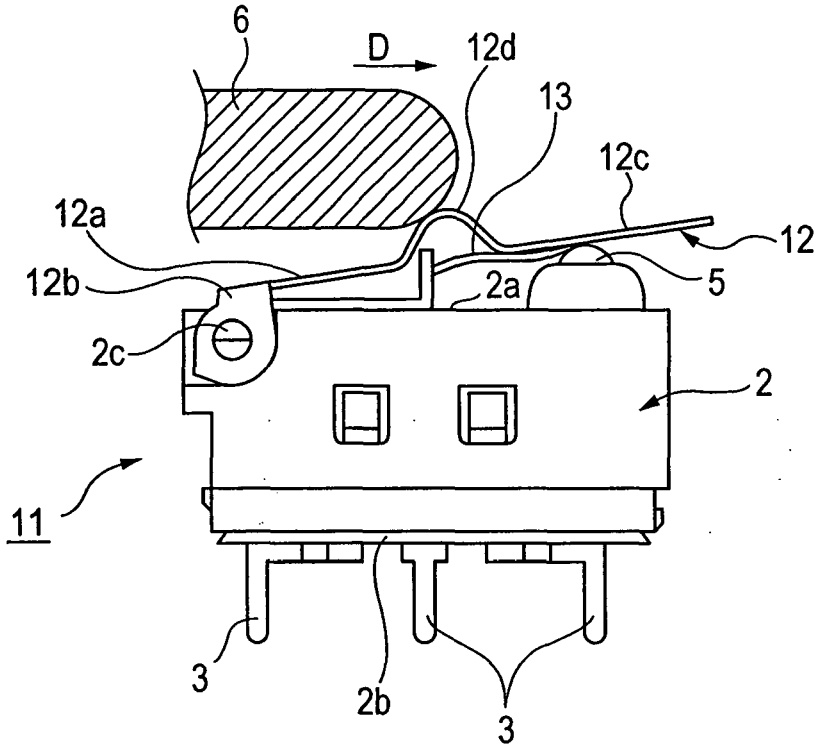

FIG. 6

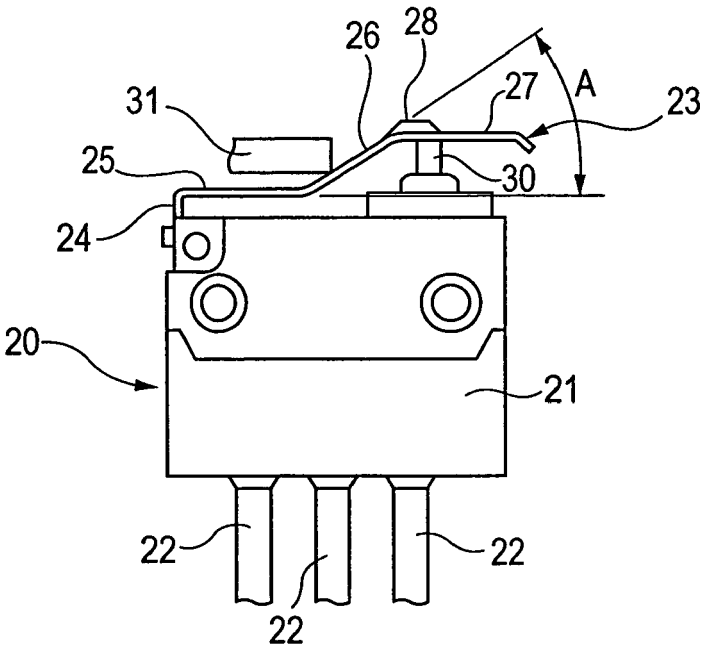
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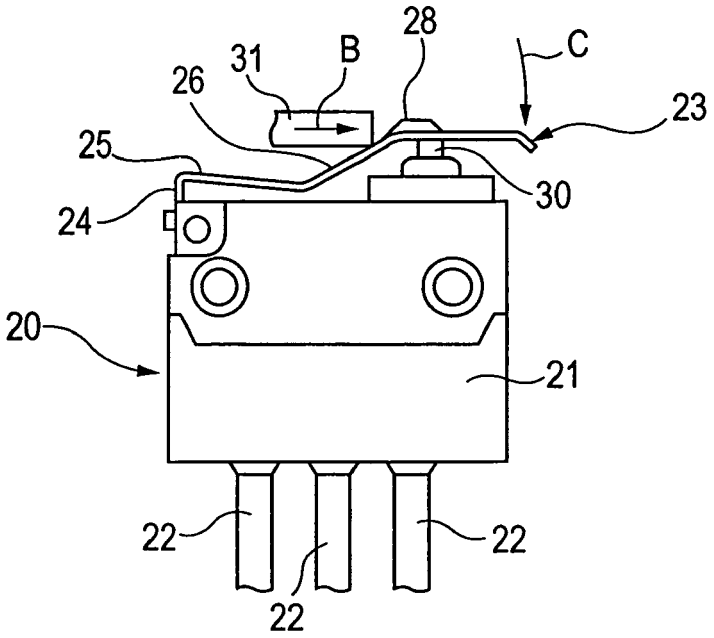
FIG. 7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Patent documents cited in the description

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