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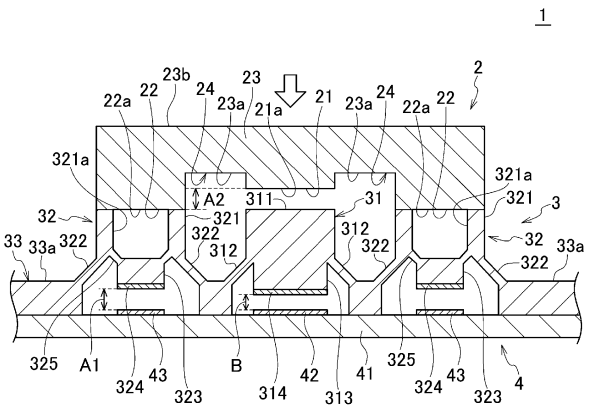
(54) **PUSH-BUTTON SWITCH**

(57) To provide a push button switch that is capable of performing a two-stage input operation, that enables a pressing operation portion to be depressed without causing the pressing operation portion to interfere with other portions to achieve a smooth input operation, and that generates a desirable clicking sensation.

A push button switch includes a plunger 2 including a first pusher portion 21 and a second pusher portion 22 that is apart from the first pusher portion 21; a first actuating portion 31 including a first body portion 311, a first skirt portion 312, and a first movable contact 314; and a second actuating portion 32 including a second body portion, a second skirt portion 322, and a second movable contact 324. When the plunger 2 is depressed by a distance A1, the second skirt portion 322 buckles and the second movable contact 324 comes into contact with a second circuit contact 43 on a circuit board 4 and the first pusher portion 21 comes into contact with the first body portion 311. When the plunger 2 is depressed by a distance B, the first skirt portion 312 buckles and the first movable contact 314 comes into contact with a second circuit contact 42.

Fig.4



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Description

Technical Field

[0001] The present invention relates to push button switches mounted on, for example, domestic, on-board, and portable electrical devices to perform an input operation, and more particularly to a push button switch capable of performing a two-stage input operation in response to a single continuous pressing operation.

Background Art

[0002] Push button switches have been widely used in, for example, domestic, on-board, and portable electrical devices.

[0003] A push button switch is configured to perform an on/off operation of a circuit when a pressing operation portion is depressed so that a movable contact provided on a pusher side comes into contact with a circuit contact provided on a circuit board side. When the pressing operation portion is depressed, a skirt portion that elastically supports the pusher buckles to generate a clicking sensation, which the operator feels on their finger. Thus, the operator is provided with a feel of operation.

[0004] An example of an existing push button switch is capable of performing a two-stage input operation in response to a single continuous pressing operation. For example, PTL 1 discloses a push button which operates a plurality of switch actuating portions, which are arranged in parallel along a single plane, when a single key knob that serves as a pressing operation portion is depressed.

[0005] The push button switch according to PTL 1 includes a first switch actuating portion and second switch actuating portions positioned higher than the first switch actuating portion. When the key knob is depressed, first, skirt portions of the second switch actuating portions, which are in contact with the key knob, buckle and movable contacts provided on the second switch actuating portions come into contact with fixed contacts on a circuit board.

[0006] When the key knob in this state is further depressed, a skirt portion of the first switch actuating portion buckles and the skirt portions of the second switch actuating portions further buckle so that a movable contact provided on the first switch actuating portion comes into contact with a fixed contact on the circuit board. Thus, a two-stage input operation can be performed in response to a single action.

Citation List

Patent Literature

[0007] PTL 1: Japanese Unexamined Utility Model Registration Application Publication No. 61-149232

Summary of Invention

Technical Problem

[0008] The key knob included in the push button switch described in PTL 1 has a large flat bottom surface that contacts the first switch actuating portion and the second switch actuating portions. Therefore, when the key knob is depressed, the skirt portions of the second switch actuating portions that buckle and are bent upward come into contact with the bottom surface of the key knob. As a result, the depression of the key knob is obstructed and a desirable clicking sensation cannot be easily generated.

[0009] The present invention has been made in light of the above-described problem, and an object of the present invention is to provide a push button switch that is capable of performing a two-stage input operation, that enables a pressing operation portion to be depressed without causing the pressing operation portion to interfere with other portions to achieve a smooth input operation, and that generates a desirable clicking sensation.

Solution to Problem

[0010] To achieve the above-described object, the present invention provides the following configuration.

[0011] According to the present invention, a push button switch that comes into conductive contact with circuit contacts of a circuit board includes a pressing operation portion including a main portion, a first pusher portion that projects from the main portion, and a second pusher portion that is apart from the first pusher portion; a first actuating portion including a first body portion positioned to face the first pusher portion, a first skirt portion formed of a rubber elastic body that is continuously connected to a lower peripheral part of the first body portion and elastically supports the first body portion, and a first movable contact provided at a bottom of the first body portion; and a second actuating portion including a second body portion formed of a tubular rubber elastic body positioned to face the second pusher portion and having a cavity therein, a second skirt portion formed of a rubber elastic body that is continuously connected to a lower peripheral part of the second body portion and elastically supports the second body portion, and a second movable contact provided at a bottom of the second body portion. When the pressing operation portion is depressed by a first distance while the second pusher portion is in contact with the second body portion, the second skirt portion buckles, the second movable contact comes into contact with one of the circuit contacts of the circuit board, and the first pusher portion comes into contact with the first body portion. When the pressing operation portion is depressed by a second distance while the first pusher portion is in contact with the first body portion, the first skirt portion buckles and the first movable contact comes into contact with another one of the circuit contacts of the circuit

board.

[0012] Since the first pusher portion and the second pusher portion are apart from each other and has a gap therebetween, the first skirt portion and the second skirt portion that buckle and are bent upward can be received by the gap and do not come into contact with the pressing operation portion. Therefore, the pressing operation portion can be smoothly depressed.

[0013] Only the second skirt portion buckles in the first-stage operation, and the first skirt portion buckles in the second-stage operation. Accordingly, the depression resistance applied to the pressing operation portion differs between the first-stage operation and the second-stage operation. Thus, different clicking sensations can be generated in the first-stage operation and the second-stage operation.

[0014] According to the present invention, the first pusher portion may be shorter than the second pusher portion.

[0015] When the first pusher portion is shorter than the second pusher portion, a large space for accommodating the first actuating portion can be provided. Therefore, the height of the first skirt portion of the first actuating portion can be increased so that the first skirt portion easily buckles, and the first actuating portion can be easily depressed.

[0016] According to the present invention, the first body portion may be shorter than the second body portion.

[0017] Also when the first body portion is shorter than the second body portion, a large space for accommodating the first actuating portion can be provided. Therefore, the height of the first skirt portion of the first actuating portion can be increased so that the first skirt portion easily buckles, and the first actuating portion can be easily depressed.

[0018] According to the present invention, the second skirt portion may be thinner than the second body portion.

[0019] When the second skirt portion is thinner than the second body portion, it is possible to cause only the second skirt portion to buckle in the first-stage operation and cause the second body portion to be compressed in the second-stage operation. Accordingly, the depression resistance applied to the pressing operation portion differs between the first-stage operation and the second-stage operation. Thus, different clicking sensations can be generated in the first-stage operation and the second-stage operation.

[0020] In the present invention, the second body portion may have a recess portion at an end thereof.

[0021] When the second body portion has a recess portion at an end thereof, the air in the second body portion can easily flow out of the second body portion when the second body portion is depressed by the second pusher portion. Accordingly, the second body portion can be easily compressed.

[0022] In the present invention, the second pusher portion may have a groove at an end thereof.

[0023] Also when the second pusher portion has a groove at an end thereof, the air in the second body portion can easily flow out of the second body portion when the second body portion is depressed by the second pusher portion. Accordingly, the second body portion can be easily compressed.

[0024] In the present invention, the second pusher portion may have a protrusion at an end thereof.

[0025] Also when the second pusher portion has a protrusion at an end thereof, the air in the second body portion can easily flow out of the second body portion when the second body portion is depressed by the second pusher portion. Accordingly, the second body portion easily buckles. Advantageous Effects of Invention

[0026] According to the above-described present invention, the pressing operation portion can be smoothly depressed without causing the pressing operation portion to interfere with other portions, and a desirable clicking sensation can be generated. Accordingly, an electronic device including the push button switch according to the present invention provides an appropriate feel of operation and reduces the risk of misoperation when a user carries out a two-stage input operation of the electronic device.

Brief Description of Drawings

[0027]

[Fig. 1] Fig. 1 is an exploded sectional view of a push button switch according to a first embodiment of the present invention.

[Fig. 2] Fig. 2 is a bottom view of a plunger included in the push button switch illustrated in Fig. 1.

[Fig. 3] Fig. 3 is a plan view of a switch actuator included in the push button switch illustrated in Fig. 1.

[Fig. 4] Fig. 4 is a sectional view illustrating the push button switch illustrated in Fig. 1 in an initial state.

[Fig. 5] Fig. 5 is a sectional view illustrating the plunger that has been depressed from the position illustrated in Fig. 4.

[Fig. 6] Fig. 6 is a sectional view illustrating the plunger that has been further depressed from the position illustrated in Fig. 5.

[Fig. 7] Fig. 7 is a sectional view illustrating the plunger that has been further depressed from the position illustrated in Fig. 6.

[Fig. 8] Fig. 8 is a sectional view illustrating a push button switch according to a second embodiment.

[Fig. 9] Fig. 9 is a bottom view of a plunger included in a push button switch according to a first modification.

[Fig. 10] Fig. 10 is a plan view of a switch actuator included in a push button switch according to a second modification.

Description of Embodiments

[0028] A push button switch according to an embodi-

ment of the present invention will now be described with reference to the accompanying drawings.

Push Button Switch of First Embodiment [Fig. 1]

[0029] A push button switch 1, which comes into conductive contact with circuit contacts of a circuit board, includes a plunger 2 that serves as a "pressing operation portion" and a switch actuator 3 provided below the plunger 2. The push button switch 1 is capable of performing a two-stage operation.

Plunger [Figs. 1 and 2]

[0030] The plunger 2 includes an elongated-plate-shaped main portion 23, a first pusher portion 21 that projects from the main portion 23 at a central position in a longitudinal direction thereof, and two second pusher portions 22 that project farther than the first pusher portion 21 does from the main portion 23 at both ends in the longitudinal direction thereof. The plunger 2 has a top surface 23b that serves as an operation surface of the push button switch 1.

[0031] The plunger 2 may be made of any material, such as hard resin, metal, or wood, as long as the material is hard enough to be able to depress the switch actuator 3.

[0032] The first pusher portion 21 is rectangular and projects from a bottom surface 23a of the main portion 23 at a central position in the longitudinal direction thereof. A width W1 of the first pusher portion 21 in a lateral direction thereof (longitudinal direction of the plunger 2) is greater than or equal to a diameter of a first actuating portion 31, which will be described below. Accordingly, the first actuating portion 31 can be reliably depressed when the plunger 2 is depressed. The bottom surface of the first pusher portion 21 serves as a contact surface 21a that comes into contact with the first actuating portion 31.

[0033] The second pusher portions 22 are rectangular and project from the bottom surface 23a of the main portion 23 at both ends in the longitudinal direction of the plunger 2. The first pusher portion 21 and the second pusher portions 22 are apart from each other with gaps defined by grooves 24 therebetween. Accordingly, even when a first skirt portion 312 and second skirt portions 322, which will be described below, buckle and are bent to be arched upward so that the bent portions reach a height above the upper ends of the second pusher portions 22, the bent portions are received by the gaps and prevented from coming into contact with the plunger 2 and obstructing the depression of the plunger 2.

[0034] A width W2 of the second pusher portions 22 in a lateral direction thereof (longitudinal direction of the plunger 2) is greater than or equal to a diameter of second actuating portions 32, which will be described below. Accordingly, the second actuating portions 32 can be reliably depressed when the plunger 2 is depressed. In particular, the width W2 of the second pusher portions 22 is preferably greater than the diameter of the second actuating portions 32. Such a configuration eliminates the risk that the plunger 2 will not be able to return to the initial position due to second body portions 321 of the second actuating portions 32 covering and engaging with the second pusher portions 22 when the second body portions 321 are compressed and deformed, as described below. The bottom surfaces of the second pusher portions 22 serve as contact surfaces 22a that come into contact with the second actuating portions 32.

Switch Actuator [Figs. 1 and 3]

[0035] The switch actuator 3 is formed of a rubber elastic body, and includes an elongated-plate-shaped base portion 33, a first actuating portion 31 arranged to project above the base portion 33 and face the first pusher portion 21, and two second actuating portions 32 arranged to project above the base portion 33 and face the second pusher portions 22.

[0036] Examples of the material of the switch actuator 3 include synthetic rubbers and thermoplastic elastomers (TPEs), more specifically, silicone rubber, urethane rubber, fluorine rubber, nitrile rubber, ethylene propylene rubber, styrene-based TPE, olefin-based TPE, urethane-based TPE, and polyester-based TPE. Among these materials, silicone rubber is preferred because it has less variation in hardness at high and low temperatures, high durability, and smaller permanent compressive strain.

[0037] The base portion 33 is an elongated-plate-shaped member. The first actuating portion 31 and the two second actuating portions 32 project from a top surface 33a of the base portion 33 and are aligned next to each other.

[0038] The first actuating portion 31 includes a first body portion 311 positioned to face the first pusher portion 21, the first skirt portion 312 continuously connected to a lower peripheral part of the first body portion 311, and a first movable contact 314 provided on the bottom of the first body portion 311.

[0039] The first body portion 311 has a solid cylindrical structure and is elastically supported by the first skirt portion 312 on the base portion 33. The first body portion 311 includes a cylindrical pressing portion 313 that projects at the bottom thereof, and the first movable contact 314 is provided at the end of the pressing portion 313.

[0040] The first skirt portion 312, which is truncated-cone-shaped, stands on the base portion 33 and has a thickness less than that of the base portion 33. The first skirt portion 312 elastically supports the first body portion 311 on the base portion 33.

[0041] The first movable contact 314, which is a conductive member, is formed by arranging, for example, a conductive coating film, a metal plate, or a thin metal wire on the bottom surface of the first body portion 311.

[0042] The second actuating portions 32 include second body portions 321 positioned to face the respective second pusher portions 22, second skirt portions 322

continuously connected to lower peripheral parts of the second body portions 321, and second movable contacts 324 provided below the second body portions 321. The two second actuating portions 32 are provided around the first actuating portion 31. The first actuating portion 31 and the two second actuating portions 32 are aligned next to each other.

[0043] The second body portions 321 have cylindrical structures with cavities 321a formed therein, and are elastically supported by the second skirt portions 322 on the base portion 33. Pressing portions 323 having a solid cylindrical shape are continuously connected to the second body portions 321 by thin-walled connecting portions 325 at the bottom of the second body portions 321. The second movable contacts 324 are provided at ends of the pressing portions 323. The second body portions 321 and the first body portion 311 are at the same height.

[0044] The second skirt portions 322, which are truncated-cone-shaped, stand on the base portion 33 and have a thickness less than those of the base portion 33 and the second body portions 321. The second skirt portions 322 elastically support the second body portions 321 on the base portion 33. When the second actuating portions 32 are depressed by the second pusher portions 22, first, the thin-walled second skirt portions 322 buckle, and then the thick-walled second body portions 321 are compressed.

[0045] The second movable contacts 324, which are conductive members, are formed by arranging, for example, conductive coating films, metal plates, or thin metal wires on the bottom surfaces of the pressing portions 323.

[0046] Since multiple second actuating portions 32 are arranged adjacent to the first actuating portion 31, the plunger 2 is not tilted when depressed, and can be easily vertically depressed.

Circuit Board [Fig. 1]

[0047] The circuit board 4 includes a first circuit contact 42 and second circuit contacts 43 formed on a surface of a board body 41. The first circuit contact 42 is positioned to face the first movable contact 314, and the second circuit contacts 43 are positioned to face respective ones of the two second movable contacts 324. The first circuit contact 42 and the two second circuit contacts 43 are aligned next to each other.

[0048] The board body 41 is formed by applying a rolled copper foil to, for example, a flexible circuit board including a base composed of a polyethylene terephthalate film, a polyethylene naphthalate film, or a polyimide film or a rigid circuit board including a glass epoxy or glass composite base, and etching the copper foil into a desired circuit pattern.

[0049] The first circuit contact 42 and the second circuit contacts 43 are made of a conductive metal, and are formed in a pattern including comb-shaped opposing portions or concentric circles. The surfaces of the first circuit contact 42 and the second circuit contacts 43 are covered with a protecting layer, such as a gold plating film or a conductive layer made of carbon ink, to prevent corrosion.

[0050] A distance B between the first circuit contact 42 and the first movable contact 314 is less than a distance A1 between each second circuit contact 43 and the corresponding second movable contact 324. Since the distance B1 is less than the distance A1, a distance by which the plunger 2 is depressed in a second-stage operation, in which the plunger 2 receives a greater depression resistance than in a first-stage operation, can be reduced and operation load in the second-stage operation can be reduced accordingly.

[0051] The distance A1 between each second circuit contact 43 and the corresponding second movable contact 324 is equal to a height difference A2 between the first pusher portion 21 and the second pusher portions 22.

Operation of Push Button Switch [Figs. 4 to 7]

[0052] The operation of the above-described push button switch 1 will now be described. Fig. 1 illustrates the plunger 2 and the switch actuator 3 are in a separated state for convenience of description. However, in practice, the second pusher portions 22 of the plunger 2 are in contact with the second body portions 321 of the second actuating portions 32, as illustrated in Fig. 4, when the first-stage operation is started. Thus, Fig. 4 shows the initial state of the push button switch 1. In the initial state, the distance between each second movable contact 324 and the corresponding second circuit contact 43 is A1. The distance between the contact surface 21a of the first pusher portion 21 and the top surface of the first body portion 311 is A2, which is equal to A1. The distance between the first movable contact 314 and the first circuit contact 42 is B, which is less than A1.

[0053] When the plunger 2 in the initial state is depressed, the second skirt portions 322 of the second actuating portions 32 buckle, as illustrated in Fig. 5. At this time, the operator feels a clicking sensation generated by the buckling of the second skirt portions 322.

[0054] As the plunger 2 is depressed, the second skirt portions 322 buckle and are upwardly bent. Since the grooves 24 are formed in the plunger 2, the second skirt portions 322 in the bent state are received by the spaces defined by the grooves 24 and are prevented from coming into contact with the plunger 2. Accordingly, the second skirt portions 322 in the bent state are prevented from obstructing the depression of the plunger 2 by coming into contact with the plunger 2, and the plunger 2 can be smoothly depressed in the first-stage operation and the second-stage operation, which will be described below.

[0055] When the second body portions 321 are further pushed downward, as illustrated in Fig. 6, the second movable contacts 324 provided below the second body portions 321 come into contact the second circuit contacts 43 on the circuit board 4, and are electrically con-

nected to the second circuit contacts 43. The second pusher portions 21 are moved downward from the initial positions thereof by the distance A1, and accordingly the first pusher portion 21 is also moved downward by the distance A2, which is equal to the distance A1. As a result, the first pusher portion 21 comes into contact with the first body portion 311. Thus, the first-stage operation is completed.

[0056] In this state, the second movable contacts 324 are in contact with the second circuit contacts 43 and the first pusher portion 21 is in contact with the first body portion 311. Therefore, the resistance against the depression of the plunger 2 increases, and the user recognizes that the first-stage operation has been completed.

[0057] Next, the second-stage operation is started. When the plunger 2 is further depressed from the position illustrated in Fig. 6, the second body portions 321 of the second actuating portions 32 are compressed, and the first skirt portion 312 of the first actuating portion 31 and the connecting portions 325 buckle. Accordingly, the first body portion 311 that is in contact with the first pusher portion 21 is depressed. At this time, the user feels a clicking sensation generated by the buckling of the skirt portion 312 and the connecting portions 325.

[0058] As the plunger 2 is depressed, the first skirt portion 312 buckles and is upwardly bent. Since the grooves 24 are formed in the plunger 2, the first skirt portion in the bent state is received by the spaces defined by the grooves 24 and is prevented from coming into contact with the plunger 2. Accordingly, the first skirt portion 312 in the bent state is prevented from obstructing the depression of the plunger 2 by coming into contact with the plunger 2, and the plunger 2 can also be smoothly depressed in the second-stage operation.

[0059] To enable the user to distinguish between the first-stage operation and the second-stage operation based on the feel of operation, the depression resistance in the second-stage operation needs to be greater than the depression resistance in the first stage.

[0060] The resistance in the first-stage operation depends only on the buckling resistance of the second skirt portions 322. In contrast, the resistance in the second-stage operation is the sum of the compressive resistance of the second body portions 321, which have a greater thickness and a greater resistance than the second skirt portions 322, and the buckling resistances of the first skirt portion 312 and the connecting portions 325.

[0061] Accordingly, the depression resistance in the second-stage operation is greater than the depression resistance in the first-stage operation. This enables the user to distinguish between the first-stage operation and the second-stage operation based on the feel of operation.

[0062] The connecting portions 325 that have buckled exerts an elastic restoring force that continuously presses the second movable contacts 324 against the second circuit contacts 43 during the second-stage operation. Accordingly, the second movable contacts 324 and the second circuit contacts 43 that are in conductive contact with each other can be prevented from becoming separated from each other during the second-stage operation.

[0063] Back to Fig. 6, when the plunger 2 is further depressed from the illustrated position, the first body portion 311 is further depressed and the first skirt portion 312 further buckles, as illustrated in Fig. 7, so that the first movable contact 314 provided on the bottom of the first body portion 311 comes into contact with the first circuit contact 42 on the circuit board 4 and is electrically connected to the first circuit contact 42. Thus, the second-stage operation is completed.

[0064] In this state, the first movable contact 314 and the first circuit contact 42 are in contact with each other, so that the resistance against the depression of the plunger 2 increases and the user recognizes that the second-stage operation has been completed.

Effects of Push Button Switch

[0065] The push button switch 1 according to the above-described embodiment includes the plunger 2 having the grooves 24 formed between the first pusher portion 21 and the second pusher portions 22. Therefore, the first skirt portion 312 and the second skirt portions 322, which buckle and are bent upward when the plunger 2 is depressed, are received by the spaces defined by the grooves 24 and are prevented from coming into contact with the bottom surface of the plunger 2.

[0066] Accordingly, the first skirt portion 312 and the second skirt portions 322 in the upwardly bent state are prevented from obstructing the depression of the plunger 2 by coming into contact with the bottom surface of the plunger 2, and the plunger 2 can be smoothly depressed in both the first-stage operation and the second-stage operation.

[0067] In addition, since the first pusher portion 21 is shorter than the second pusher portions 22 on the main portion 23, a large space can be provided below the first pusher portion 21. Accordingly, a large space for accommodating the first actuating portion 31 can be provided, and the heights of the first body portion 311 and the first skirt portion 312 of the first actuating portion 31 can be increased.

[0068] As the heights of the first body portion 311 and the first skirt portion 312 are increased, the first skirt portion 312 more easily buckles. Therefore, the first actuating portion 31 can be more easily depressed in the second-stage operation.

Push Button Switch of Second Embodiment [Fig. 8]

[0069] The push button switch 1 according to the first embodiment is configured such that the first pusher portion 21 is shorter than the second pusher portions 22, so that the height of the first skirt portion 312 of the first actuating portion 31 can be increased to enable easy buckling of the first skirt portion 312.

[0070] However, the present invention is not limited to this. As illustrated in Fig. 8, a first body portion 311' may be formed to have a smaller height without changing the height of the first skirt portion 312, and a first pusher portion 21' may be formed to have the same height as the second pusher portions 22. In Fig. 8, components similar to those in Fig. 1 are denoted by the same reference signs.

[0071] A push button switch 1' having the above-described structure has effects similar to those of the push button switch 1 according to the above-described first embodiment. In addition, since it is not necessary to form the plunger 2' so that the first pusher portion 21' and the second pusher portions 22 have different heights, the plunger 2' can be more easily designed.

Modifications of Embodiments

[0072] The present invention is not limited to the above-described embodiments, and various modifications are possible.

[0073] For example, during the second-stage operation of the push button switch 1 according to the above-described embodiment, there is a possibility that the air in the cavities 321a in the second body portions 321 cannot easily flow out of the cavities 321a. When the air cannot easily flow out of the cavities 321a, the second body portions 321 cannot be easily compressed and the second-stage operation cannot be smoothly performed.

[0074] Accordingly, as illustrated in Fig. 9, cross-shaped grooves 221 for releasing the air may be formed at the ends of the second pusher portions 22 of the plunger 2.

[0075] The grooves 221 enable the air in the second body portions 321 to easily flow out when the plunger 2 depresses the switch actuator 3. Accordingly, the second body portions 321 can be easily compressed.

[0076] The shape of the grooves 221 is not limited to a cross shape. However, when the grooves 221 are cross-shaped, the second body portions 321 can be prevented from receiving non-uniform pressing force.

[0077] Cross-shaped protrusions may be formed instead of the cross-shaped grooves 221 at the ends of the second pusher portions 22 of the plunger 2. Also in this case, effects similar to those of the cross-shaped grooves 221 can be obtained.

[0078] As illustrated in Fig. 10, recess portions 326 may be formed at the ends of the second body portions 321 of the second actuating portions 32. Also in this case, the air in the second body portions 321 easily flows out, and the second body portions 321 can be easily compressed. When four recess portions 326 having the same shape are formed so as to extend in respective directions, the second body portions 321 can be prevented from receiving non-uniform pressing force. The second body portions 321 are referred to as being tubular even when the recess portions 326 are formed therein.

[0079] Although the above-described push button switch 1 includes two second actuating portions 32, the number of second actuating portions 32 is not limited to two in the present invention, and may instead be one, or three or more. The number of second pusher portions 22 of the plunger 2 is changed in accordance with the number of second actuating portions 32.

[0080] To enable easy depression of the first actuating portion 31 and the second actuating portions 32, a structure for releasing air from the spaces surrounded by the base portion 33, the first actuating portion 31, the second actuating portions 32, and the circuit board 4 is preferably provided. Accordingly, for example, ventilation holes or air grooves for releasing air may be formed in the base portion 33 or the board body 41.

[0081] In addition, although the first actuating portion 31 and the two second actuating portions 32 are aligned next to each other in the above-described embodiment, the present invention is not limited to this, and any arrangement may be employed.

[0082] In addition, although the main portion 23 of the plunger 2, 2' is elongated-plate-shaped in the above-described embodiment, the present invention is not limited to this, and the main portion 23 may have any shape, such as a curved shape.

[0083] In addition, although the second actuating portions include the connecting portions 325 capable of buckling and the pressing portions 323 connected to the connecting portions 325 in the above-described embodiments, the present invention is not limited to this. The connecting portions 325 and the pressing portions 323 may be omitted, and the movable contacts 324 may be formed directly on the bottom of the tubular second body portions 321.

Reference Signs List

[0084]

1, 1' push button switch
2, 2' plunger
3, 3' switch actuator
4 circuit board
21, 21' first pusher portion
22 second pusher portion
23 main portion
31 first actuating portion
32 second actuating portion
33 base portion
41 board body
42 first circuit contact
43 second circuit contact
221 groove
311 first body portion
312 first skirt portion
313 pressing portion
314 first movable contact
321 second body portion
321a cavity

322 second skirt portion
323 pressing portion
324 second movable contact
325 connecting portion

Claims

1. A push button switch that comes into conductive contact with circuit contacts of a circuit board, the push button switch comprising:

a pressing operation portion including a main portion, a first pusher portion that projects from the main portion, and a second pusher portion that is apart from the first pusher portion;
a first actuating portion including a first body portion positioned to face the first pusher portion, a first skirt portion formed of a rubber elastic body that is continuously connected to a lower peripheral part of the first body portion and elastically supports the first body portion, and a first movable contact provided at a bottom of the first body portion; and
a second actuating portion including a second body portion formed of a tubular rubber elastic body positioned to face the second pusher portion and having a cavity therein, a second skirt portion formed of a rubber elastic body that is continuously connected to a lower peripheral part of the second body portion and elastically supports the second body portion, and a second movable contact provided at a bottom of the second body portion,

wherein when the pressing operation portion is depressed by a first distance while the second pusher portion is in contact with the second body portion, the second skirt portion buckles, the second movable contact comes into contact with one of the circuit contacts of the circuit board, and the first pusher portion comes into contact with the first body portion, and
wherein when the pressing operation portion is depressed by a second distance while the first pusher portion is in contact with the first body portion, the first skirt portion buckles and the first movable contact comes into contact with another one of the circuit contacts of the circuit board.

2. The push button switch according to Claim 1, wherein the first pusher portion is shorter than the second pusher portion.

3. The push button switch according to Claim 1, wherein the first body portion is shorter than the second body portion.

4. The push button switch according to any one of Claims 1 to 3, wherein the second skirt portion is thinner than the second body portion.

5. The push button switch according to any one of Claims 1 to 4, wherein the second body portion has a recess portion at an end thereof.

6. The push button switch according to any one of Claims 1 to 4, wherein the second pusher portion has a groove at an end thereof.

7. The push button switch according to any one of Claims 1 to 4, wherein the second pusher portion includes a protrusion at an end thereof.

Fig.1

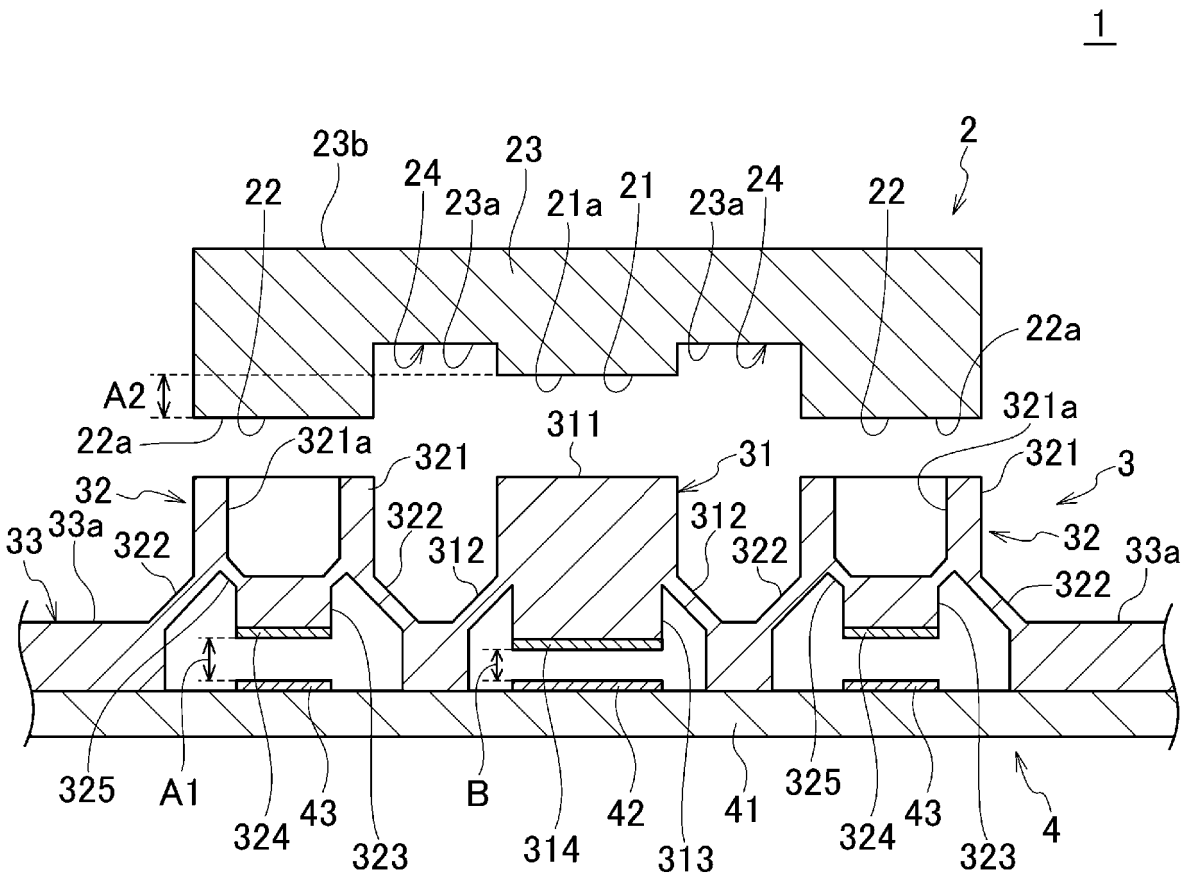
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Fig.2

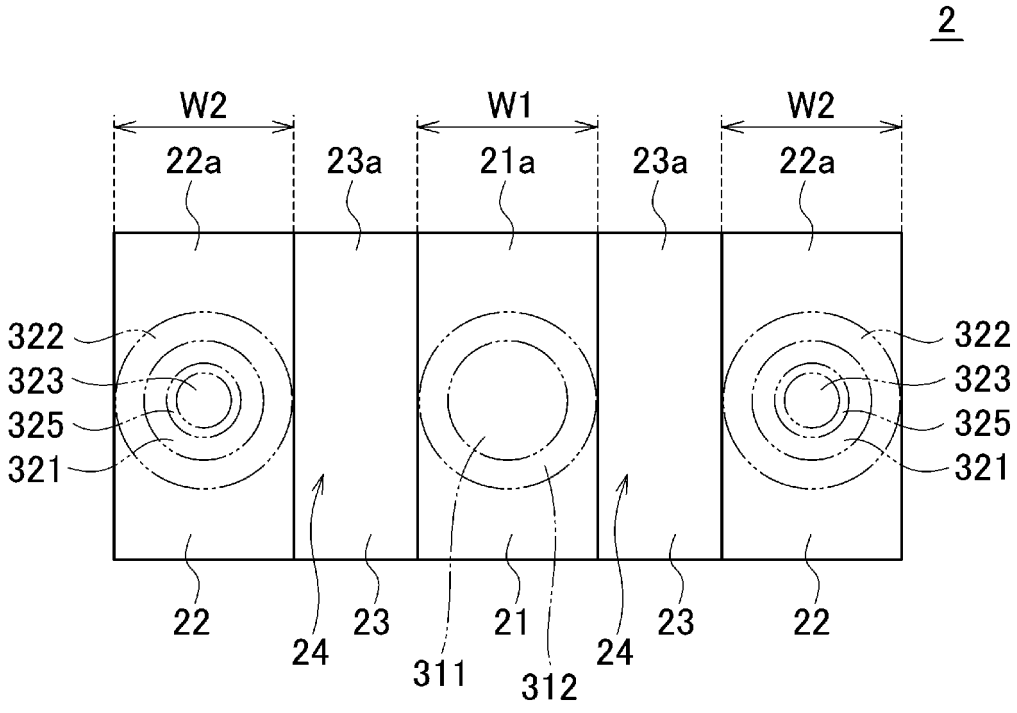
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Fig.3

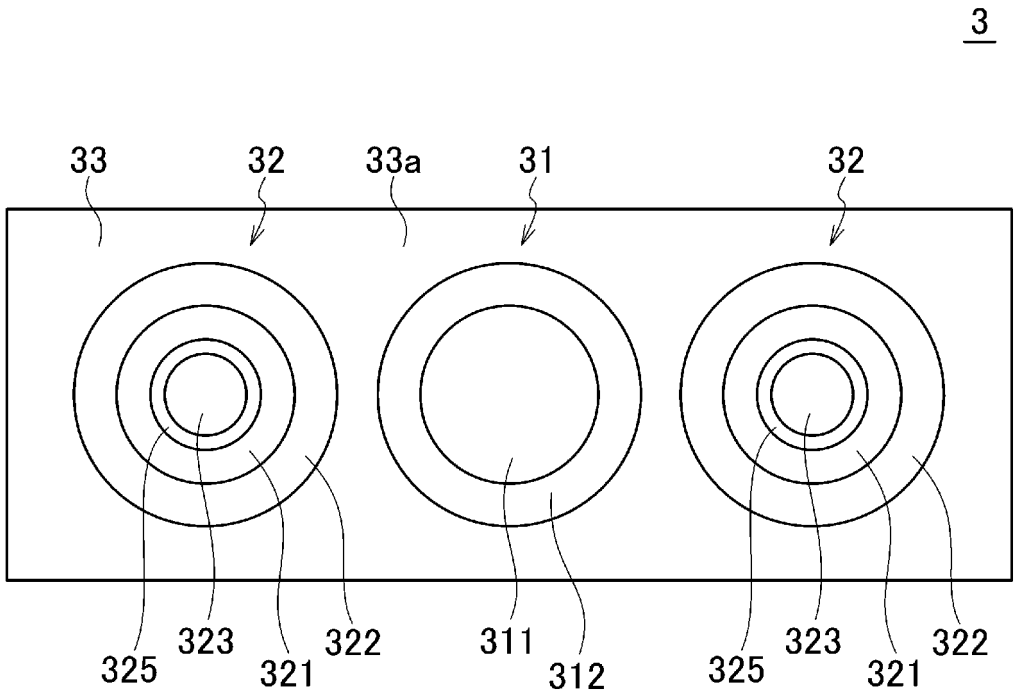

Fig.4

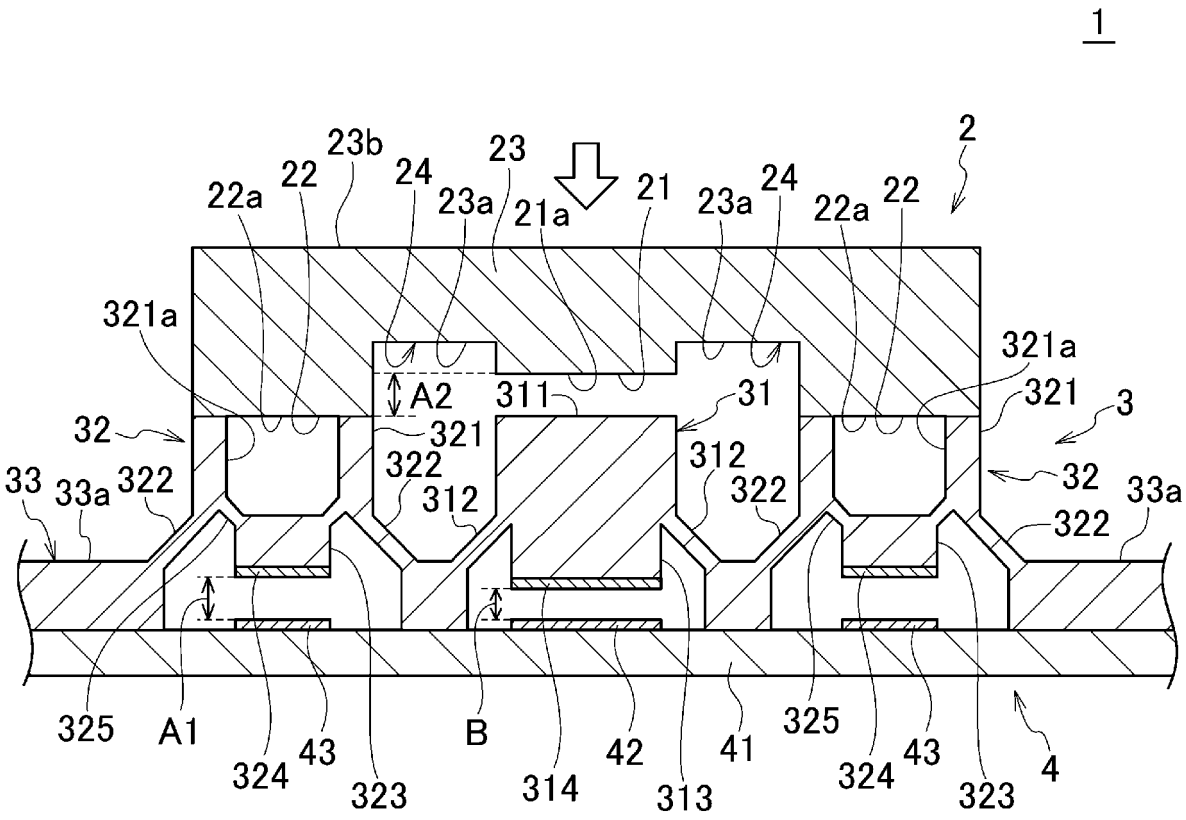
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Fig.5

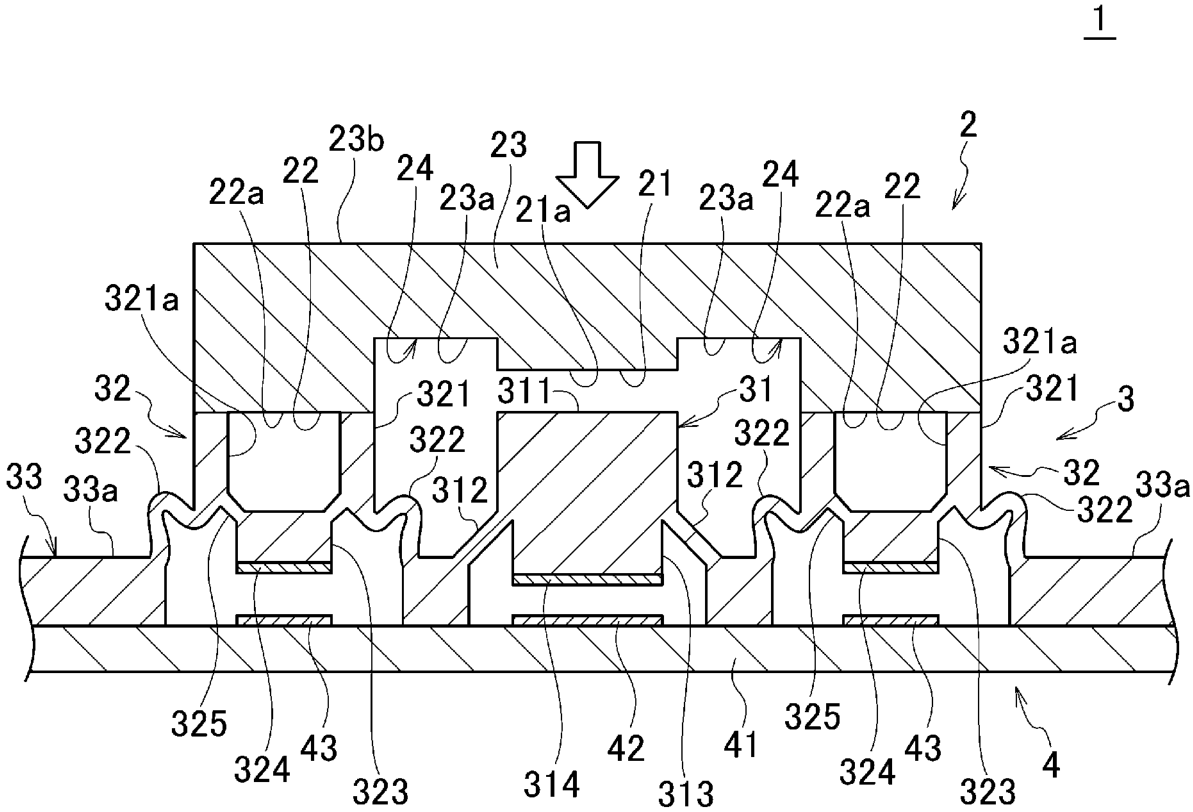
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Fig.6

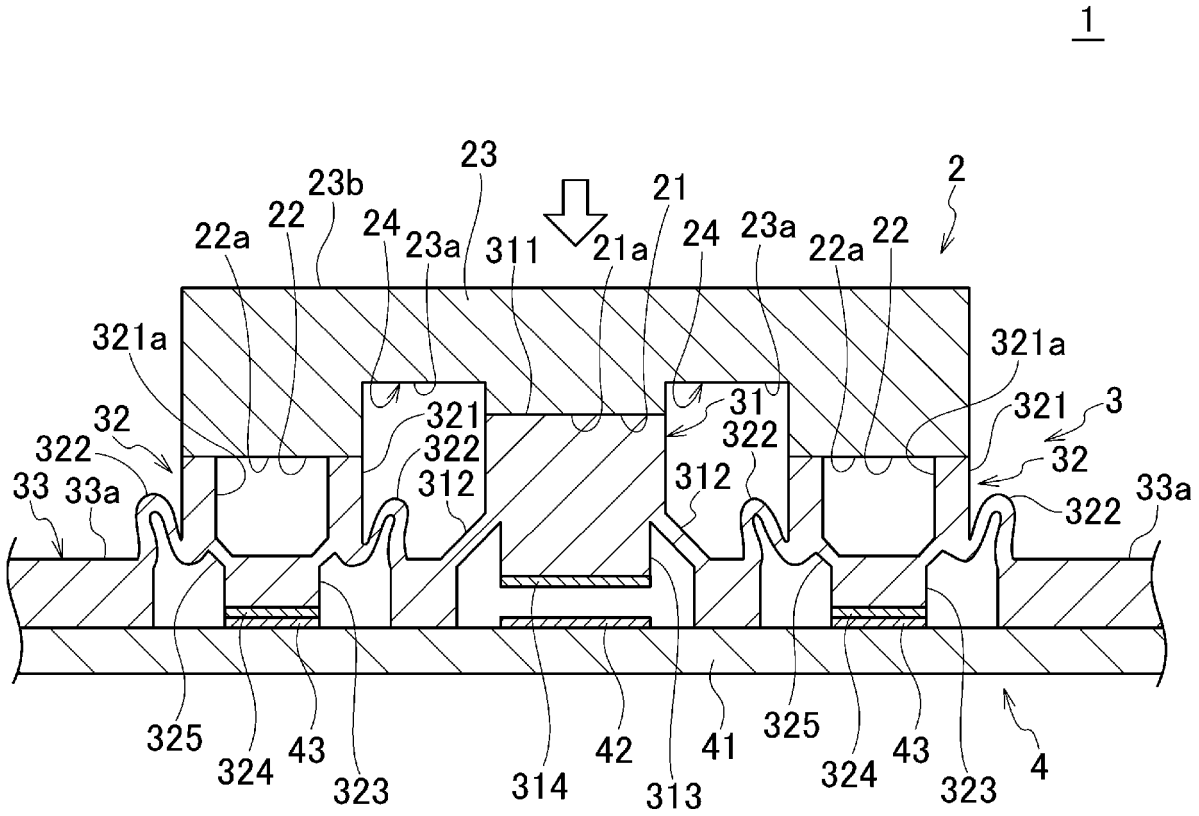
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Fig.7

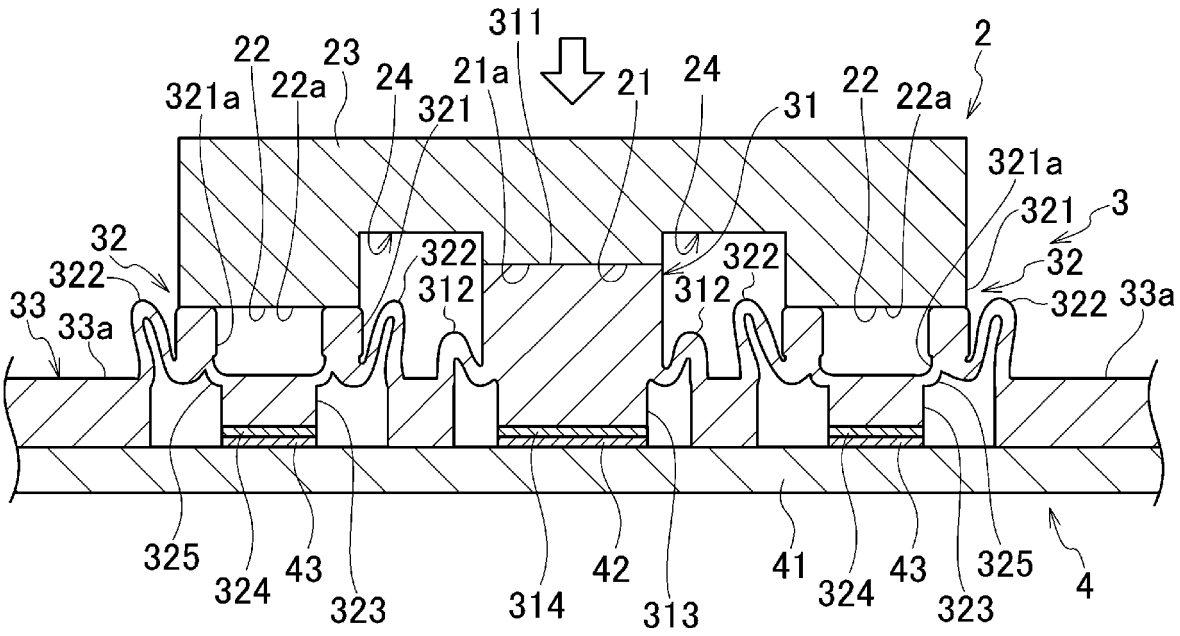
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Fig.8

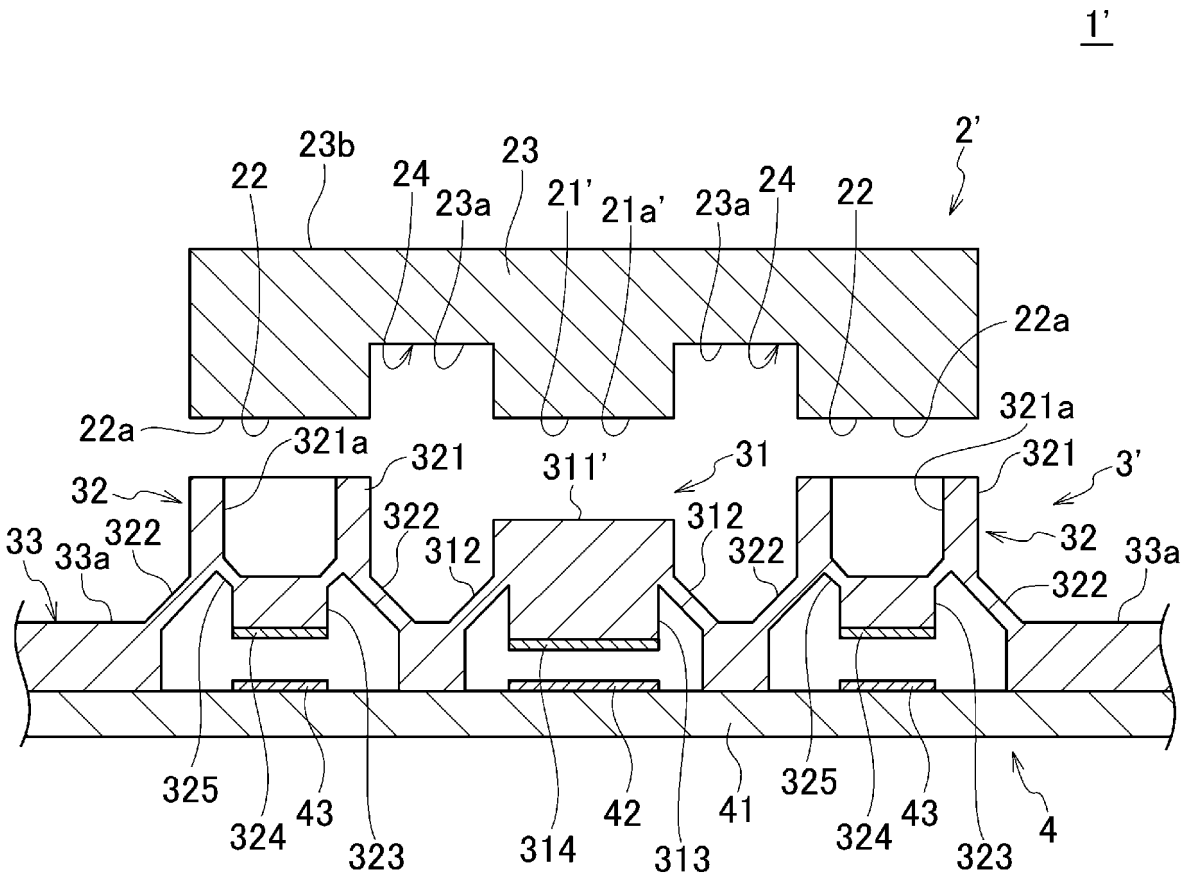
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Fig.9

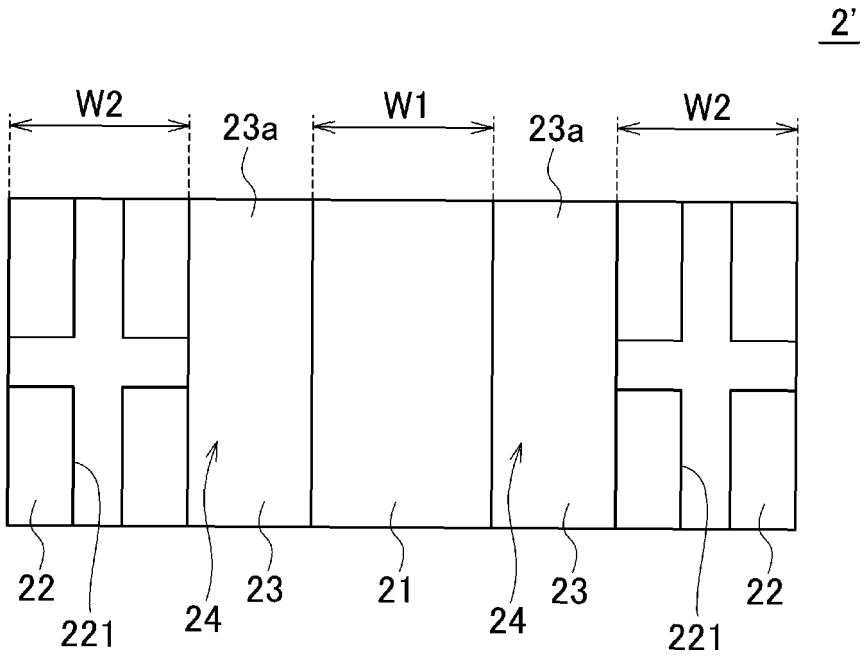
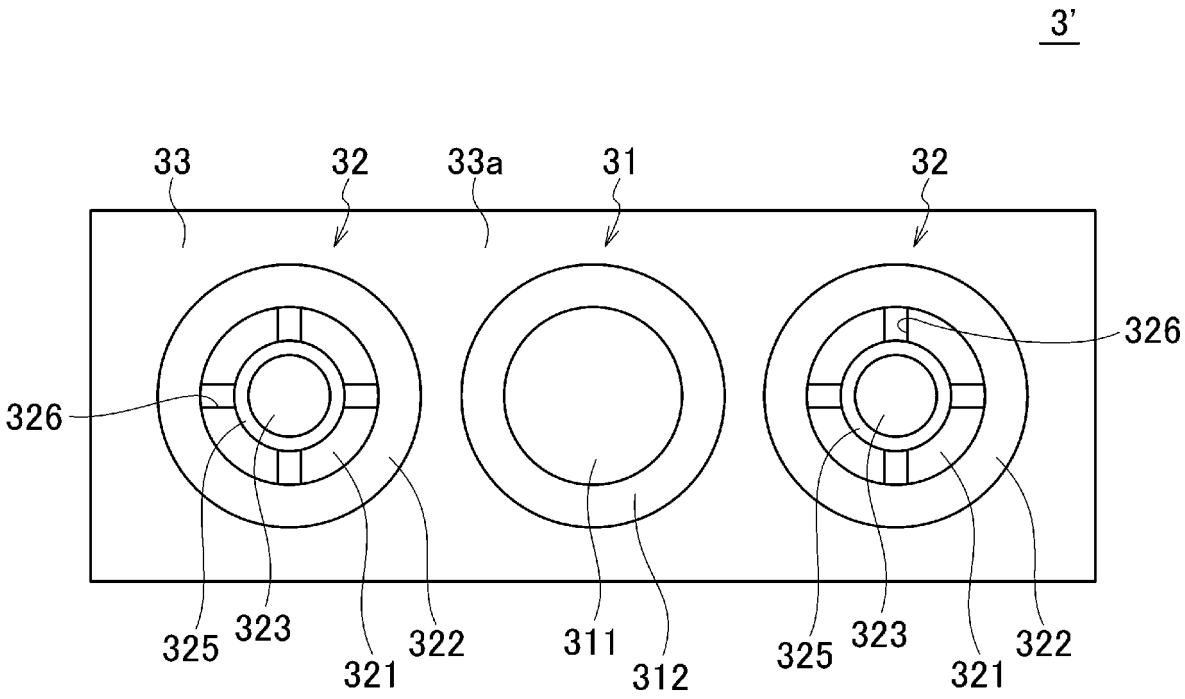


Fig.10



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/019761

A. CLASSIFICATION OF SUBJECT MATTER
H01H13/66(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01H13/66

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 032028/1985(Laid-open No. 149232/1986) (Kanto Seiki Kabushiki Kaisha), 13 September 1986 (13.09.1986), specification, page 5, line 16 to page 6, line 10; fig. 1 to 3 (Family: none)	1-7

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 August 2017 (02.08.17)	15 August 2017 (15.08.17)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/019761

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 175334/1986(Laid-open No. 080727/1988) (Kenwood Corp.), 27 May 1988 (27.05.1988), specification, page 4, lines 2 to 14; page 5, lines 11 to 13; fig. 2 (Family: none)	1-7
Y	JP 2000-243179 A (Alps Electric Co., Ltd.), 08 September 2000 (08.09.2000), paragraphs [0016] to [0018]; fig. 1, 2 & US 6664901 B1 column 4, line 32 to column 5, line 10; fig. 1, 2 & TW 448455 B	5-7
A	JP 2000-123679 A (Nikon Corp.), 28 April 2000 (28.04.2000), entire text; all drawings (Family: none)	1-7
A	JP 2001-318414 A (Fuji Photo Film Co., Ltd.), 16 November 2001 (16.11.2001), entire text; all drawings (Family: none)	1-7

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Patent documents cited in the description

- JP 61149232 A **[0007]**