

SWITCH

TECHNOLOGY

[0001] Embodiments of the present disclosure relate to the field of switch, and more specifically, to a pushbutton switch.

5 BACKGROUND

[0002] A pushbutton switch refers to a switch whose pushbutton can return to its original position after each press operation. After a press, the pushbutton switch can be switched to the switching-on or switching-off state, and after a next press operation, the pushbutton switch would be switched to the opposite state (switching-off or switching-on) from the switching-on or switching-off state.

[0003] The existing pushbutton switch drives a swing element to swing via a driver, and then the swing element drives the switch bridge to act to achieve the switching on and off operation of the circuit. In such an existing pushbutton switch, the driver needs to return to the intermediate position each time when the pushbutton is released. Thus, when the pushbutton is pressed again to operate the switch, the driver needs to rotate from the intermediate position to tilt for an angle before starting to drive the swing element and further drive the moving contact of the switch to act, causing a delay between the operation of the pushbutton and the switching action of the switch, which is adverse to timely and precise control to the switch. Besides, during the rotation process of the driver, friction will be generated on the contact face between the driver and the swing element. On the one hand, if this friction face becomes coarse due to causes like dirt, manufacturing and usage, the driver might be unable to rotate, thereby disabling the switch; on the other hand, the wear caused by long-term friction might change the dimension and shape of the contact point of the driver and the swing element so that the driver cannot match with the swing element accurately to drive the swing element to act, which makes the driver's operation unstable and unreliable. Moreover, the switch of the prior art has many components, and thus has high demand for the precision of manufacturing and fitting the components, which also increases the manufacturing costs of the switch.

[0004] In another aspect, for the pushbutton switch of the prior art as mentioned above, the direction of the press force applied on the pushbutton is usually different from the driving

force for directly driving the moving contact to act. Therefore, it is necessary to utilize a particular mechanism to convert the press force applied by the user downward into the driving force for directly driving the moving contact to act. This kind of force conversion generally has poor efficiency and therefore, requires greater press force from the user. In addition, such force conversion is not reliable enough because of factors such as reliability of the particular mechanism, manufacturing precision, abrasion, pollution and so on.

SUMMARY

[0005] According to an embodiment of the present disclosure, there is provided a switch, comprising: a pushbutton having a pushbutton contact face; a driver having a driver contact face; a swing element that can swing with respect to a first axis; an elastic element connected between the driver and the swing element and causing the driver contact face of the driver to abut against the pushbutton contact face of the pushbutton; and a first moving contact and a first stationary contact. The driver is configured such that when the pushbutton is pressed down, the driver in its first swing limit position drives the swing element to swing to a first position, and when the pushbutton is released, the elastic element drives the driver to swing relative to the pushbutton to its second swing limit position, and when the pushbutton is pressed down again, the driver in its second swing limit position drives the swing element to swing to a second position; and in one of the first position and the second position, the first moving contact contacts the first stationary contact while in the other one of the first position and the second position, the first moving contact is disconnected from the first stationary contact.

[0006] According to an embodiment of the present disclosure, during the swing process of the driver, the engaging point between the driver contact face of the driver and the pushbutton contact face of the pushbutton varies.

[0007] According to an embodiment of the present disclosure, at least one of the driver contact face and the pushbutton contact face is a convex curved face.

[0008] According to an embodiment of the present disclosure, the pushbutton contact face is a profiled curved surface and the driver contact face at least has a part complementary with the shape of two ends of the profiled curved surface of the pushbutton contact face.

[0009] According to an embodiment of the present disclosure, the driver contact face and the pushbutton contact face are arranged with teeth engaging with each other.

[0010] According to an embodiment of the present disclosure, the driver contact face and the pushbutton contact face are configured with a sufficient friction coefficient to prevent producing relative sliding between the driver contact face and the pushbutton contact face during the swing process of the driver contact face relative to the pushbutton contact face.

5 **[0011]** According to an embodiment of the present disclosure, the switch further comprises a housing in which a stop is arranged, the stop defining the first swing limit position and the second swing limit position of the driver.

[0012] According to an embodiment of the present disclosure, there is arranged a stop face on the pushbutton, the stop face defining the first swing limit position and second swing limit
10 position of the driver.

[0013] According to an embodiment of the present disclosure, the elastic element is pivotally connected between the driver and the swing element.

[0014] According to an embodiment of the present disclosure, the driver is configured such that during the process of the driver pressing the swing element to cause it to swing, the driver
15 does not swing relative to the pushbutton so that, during the process of the driver pressing the swing element, the contact position between the driver and the swing element changes.

[0015] According to an embodiment of the present disclosure, the swing element comprises a swing piece on which the first moving contact is located and a driving arm the longitudinal direction of which is vertical to the swing piece, and a first contact face and a second contact
20 face extend on the driving arm and are distributed symmetrically about the first axis; the driver has a driving face for pressing the first contact face and the second contact face, and the driver is configured such that when the pushbutton is pressed down, the driving face presses one of the first contact face and the second contact face to cause the swing element to swing, and the position on the first contact face or the second contact face of the swing element
25 where the swing element is pressed by the driving face moves gradually close to an end of the first contact face and the second contact face adjacent to each other.

[0016] According to an embodiment of the present disclosure, the switch further comprises a switch bridge on which the first moving contact is located, the swing element cooperating with the switch bridge. The first contact face and the second contact face extend on the
30 driving arm and are distributed symmetrically about the first axis; the driver has a driving face for pressing one of the first contact face and the second contact face, and the driver is

configured such that when the pushbutton is pressed down, the driving face presses one of the first contact face and the second contact face to cause the swing element to swing so that the swing element drives the switch bridge to swing to the position where the first moving contact is in contact with or disconnected from the first stationary contact, and the position on the first contact face or the second contact face of the swing element where the swing element is pressed by the driving face moves gradually close to an end of the first contact face and the second contact face adjacent to each other.

[0017] According to an embodiment of the present disclosure, the extension directions of the first contact face and the second contact face from the ends of the first and second contact faces close to each other to the distal ends thereof are tilted with an angle towards one side of the first axis with respect to the direction vertical to the main face of the swing piece. The angle can be between 0 degree and 20 degrees.

[0018] According to an embodiment of the present disclosure, the driver has a planar driving face and the swing element is provided with a first contact point and a second contact point. The driver is configured such that when the pushbutton is pressed down, the driving face presses one of the first contact face and the second contact face to cause the swing element to swing, and the position on the driving face pressing the first contact point or the second contact point moves gradually close to the edge of the driving face.

[0019] According to an embodiment of the present disclosure, the switch further comprises a second moving contact and a second stationary contact. In one of the first position and the second position of the swing element, the first moving contact contacts the first stationary contact and the second moving contact is disconnected from the second stationary contact, while in the other one of the first position and the second position, the first moving contact is disconnected from the first stationary contact and the second moving contact contacts the second stationary contact.

[0020] In the switch according to the embodiments of the present disclosure, since the driver is supported in swing manner by engagement between the driver contact face and the pushbutton contact face of the pushbutton, and the engaging point between the driver contact face and the pushbutton contact face varies during the swing process of the driver, during the resetting process of the driver, the elastic element can not only reset the driver to the rightmost swing extreme position when the driver is at its leftmost swing extreme position so as to be ready for the next driving action but also reset the driver to the leftmost swing

extreme position when the driver is at its rightmost swing extreme position so as to be ready for the next driving action. In this manner, the driver may not swing during the process of driving the swing element to act so as to reduce the travelling stroke of the driver and improve accuracy and reliability of the driving mechanism driving the swing element, and during the
5 resetting process, the driver can return to the swing extreme position at the other side only by engagement between the driver contact face and the pushbutton contact face of the pushbutton.

[0021] Meanwhile, the engagement between the driver contact face and the pushbutton contact face also causes the rotation radius of the driving face of the driver to increase to
10 exceed the distance between the driving face and the connection point of the driver and the pushbutton, thereby achieving greater swing amplitude of the driver in a compact inner space of the switch, which further reduces the stroke of the driver and the pushbutton and in turn reduces the size of the switch.

[0022] In the switch according to the embodiments of the present disclosure, by arranging the
15 moving contact on the swing element, the swing element serves not only as the actuator for receiving the driving force from the driver but also as the switch bridge for directly driving the moving contact to act, which makes the operation of the driving mechanism of the switch to drive the moving contact to act more efficient and reliable, while reducing the number of components in the switch and simplifying the structure of the switch.

BRIEF DESCRIPTION OF THE DRAWINGS

20

[0023] Through the following detailed description of the example embodiments with reference to the accompanying drawings, the above and other objectives, features, and advantages will become more apparent. In the drawings:

[0024] Fig. 1 is an exploded view of a switch according to the first embodiment of the present
25 disclosure;

[0025] Fig. 2 is a front view of the pushbutton of Fig. 1;

[0026] Fig. 3 is a perspective view of the driver of Fig. 1;

[0027] Fig. 4 illustrates the matching between the pushbutton and the driver shown in Fig. 1;

[0028] Fig. 5 illustrates an alternative for the matching between the pushbutton and the driver
30 shown in Fig. 4;

[0029] Fig. 6 shows another alternative for the matching between the pushbutton and the driver shown in Fig. 4;

[0030] Fig. 7 is a perspective view of the swing element shown in Fig. 1;

[0031] Fig. 8 is a front view of the swing element shown in Fig. 1;

5 **[0032]** Fig. 9 is a sectional view of the switch in the first state shown in Fig. 1;

[0033] Fig. 10 is a sectional view of the switch in the second state shown in Fig. 1;

[0034] Fig. 11 is a sectional view of the switch in the third state shown in Fig. 1;

[0035] Fig. 12 is a sectional view of the switch in the fourth state shown in Fig. 1;

[0036] Fig. 13 is a sectional view of the switch in the fifth state shown in Fig. 1;

10 **[0037]** Fig. 14 is a schematic diagram of the switch according to the second embodiment of the present disclosure;

[0038] Fig. 15 is a schematic diagram of the switch according to the third embodiment of the present disclosure;

15 **[0039]** Fig. 16 is a schematic diagram of the switch according to the fourth embodiment of the present disclosure;

[0040] Fig. 17 is a perspective view of the switch shown in Fig. 16.

DETAILED DESCRIPTION

[0041] Various embodiments of the present disclosure will be described in detail only with examples.

20 **[0042]** Referring to Fig. 1, Fig. 1 illustrates a switch according to the first embodiment of the present disclosure. The switch can be used in various switch apparatuses for controlling on/off of a circuit. For example, at least one such switch can be mounted in a switch panel to form a switch apparatus adapted to be mounted on a wall to control the switch operation of the light, for instance.

25 **[0043]** As shown in Fig. 1, the switch comprises a housing comprised of an upper housing 91 and a lower housing 92. In the housing, there are contained a pushbutton 1, a driver 2, a swing element 3 that can swing about a first axis, an elastic element 4, a first moving contact 81 and a second moving contact 82 located on the swing element 3, a moving contact wiring terminal 83, a first stationary contact 51 and a second stationary contact 52. As shown in

Figs. 2-4, there is arranged a pushbutton contact face 11 on the pushbutton 1 and a driver contact face 21 on the driver 2. A fixing recess 23 is further arranged on the driver to pivotally mount one end of the elastic element 4. When the elastic element 4 is connected between the driver 2 and the swing element 3, the elastic recovery force of the elastic element 4 would force the driver contact face 21 of the driver 2 to abut against the pushbutton contact face 11 of the pushbutton 1. The elastic element 4 can be a pressure spring, a torsional spring or others as long as it can apply elastic recovery force to the driver 2 and the swing element 3.

[0044] In the embodiment shown in Figs. 2-3, the pushbutton contact face 11 is a convex curved face while the driver contact face 21 is a planar face, and the pushbutton contact face 11 and the driver contact face 21 are arranged with teeth. In this manner, when the driver contact face 21 abuts against the pushbutton contact face 11, the teeth on the driver contact face 21 will engage with teeth on the pushbutton contact face 11. Such a structure enables the driver 2 to swing relative to the pushbutton 1 when the driver contact face 21 moves with “rolling” (namely, no sliding relative to each other) along the pushbutton contact face 11 in the convex curved shape. During this swing process, the engaging point between the driver contact face 21 and the pushbutton contact face 11 would vary. Particularly, when the driver 2 swings to two extreme positions at the left and right sides, the driver contact face 21 will engage with two ends on the pushbutton contact face 11 respectively at its two ends farthest from each other. The change of the position of the engaging point at two swing extreme positions of the driver is advantageous for the resetting of the driver 2, which will be illustrated in detail in the following text.

[0045] The teeth engaging with each other on the driver contact face 21 and the pushbutton contact face 11 ensure that the driver contact face 21 only engages with the pushbutton contact face 11 by “rolling” during the swing process, without producing sliding therebetween, which is important for swing resetting of the driver 2 each time. To prevent producing relative sliding between the driver contact face 21 and the pushbutton contact face 11, it is also possible not to arrange the teeth and instead, to configure sufficient friction coefficient between the driver contact face 21 and the pushbutton contact face 11 so that under the action of the recovery force from the elastic element 4 on the driver 2, the driver contact face 21 and the pushbutton contact face 11 can only roll rather than slide with respect to each other. This can be implemented by increasing surface coarseness of the driver contact face 21 and the pushbutton contact face 11 or by applying a slid-resistant coating thereon.

[0046] To cause the driver 2 to swing relative to the pushbutton 1 such that the positions of the engaging points on the driver contact face 21 and the pushbutton contact face 11 are different when the driver 2 swings to the two extreme positions at the left and right sides, the driver contact face 21 and the pushbutton contact face 11 can also be configured as other shapes. For example, the driver contact face 21 can be configured as a convex curved face while the pushbutton contact face 11 is configured as a planar face, or both the driver contact face 21 and the pushbutton contact face 11 are configured as convex curved shapes.

[0047] It is also possible to arrange the pushbutton contact face 11 as a profiled curved surface and arrange the driver contact face 21 as at least having a part complementary with the shape of two ends of the profiled curved surface of the pushbutton contact face 11. For example, as shown in Fig. 5, the pushbutton contact face 11 is concave at two ends while convex in the center, and the driver contact face 21 at least has a convex part complementary with the shapes of the concave parts on the two ends. As a result, with the rolling of the driver contact face 21 from one end to the other end along the pushbutton contact face 11, the driver contact face 21 cooperates with the pushbutton contact face 11 properly at least at two swing extreme positions at the right side and left side so that the driver 2 can successfully swing around different engaging points at the two swing extreme positions. As a matter of course, it is advantageous that the intermediate part of the driver contact face 21 is also complementary with the intermediate part of the pushbutton contact face 11 so that, when the driver 2 swings to the intermediate position, the intermediate part of the driver contact face 21 also cooperates with the intermediate part of the pushbutton contact face 11 to facilitate the driver 2 swinging from one end to the other end stably.

[0048] As shown in Fig. 6, the pushbutton contact face 11 can also be an inwardly concave trapezium with rounded angles at the upper vertexes, while the driver contact face 21 at least has straight sides and rounded angles complementary with the shapes of the bevels and rounded angles of the inwardly concave trapezium, thus also enabling the driver 2 to swing from one end to the other smoothly.

[0049] Fig. 7 illustrates the swing element 3 shown in Fig. 1. The swing element 3 comprises a swing piece 34 and a driving arm 35. A first moving contact 81 and a second moving contact 82 are located on two opposite sides of the swing piece 34. The bottom of the swing piece 34 is a swing support 31 which is swingingly supported on an electrical conductive seat 84 electrically connected to the moving contact wiring terminal 83, so that the

swing element 3 can swing with respect to the first axis. The swing piece 34 is further arranged with a protrusion 36 to support the elastic element 4 pivotally. The longitudinal direction of the driving arm 35 is perpendicular to the swing piece 34, and the first contact face 32 and the second contact face 33 extend on the driving arm 35 and are distributed on different sides of the first axis symmetrically about the first axis. The swing element 3 is made of electrical conductive material at least in the swing piece 34 so that the first moving contact 81 and the second moving contact 82 on the swing piece 34 are electrically connected to the moving contact wiring terminal 83 by the swing piece 34 and the electrical conductive seat 84.

[0050] In an embodiment, the extension directions of the first contact face 32 and the second contact face 33 from an end where the two contact faces are close to each other to a distal end are tilted towards one side of the first axis for an angle A with respect to the direction vertical to the main face of the swing piece 34, so that the extension directions of the first contact face 32 and the second contact face 33 are no longer perpendicular to the main face of the swing piece 34 (shown clearly in Fig. 8), which is particularly advantageous in the operation process of the switch for reducing the stroke of the pushbutton 1 and the driver 2, as will be illustrated in detail in the following text. Advantageously, the tilting angle is between 0 and 20 degrees. For example, the tilting angle is 5 degrees.

[0051] Returning to Fig. 3, there is arranged a driving arm 24 on the driver 2, and on the end of the driving arm there is formed a driving face 22 to contact the first contact face 32 and the second contact face 33 on the swing element 3 so as to drive the swing element 3 to swing. In one embodiment, the driving face 22 is formed in a recess at one end of the driver 2 so that the driving face 22 keeps contacting the first contact face 32 or the second contact face 33 constantly during the process of driving the swing element 3 to swing and will not be disengaged therefrom.

[0052] In one embodiment, the driving face 22 on the driver 2 is non-planar, particular a convex curved face at the end of the driving arm 24 so that the position on the driving face 22 where the driving face 22 contacts the first contact face 32 or the second contact face 33 varies during the process of pressing the first contact face 32 or the second contact face 33 of the swing element 3 by the driving face 22, which is particularly advantageous in the operation process of the switch to reduce the stroke of the pushbutton 1 and the driver 2, as will be illustrated in detail in the following text.

[0053] As shown in Fig. 1 and Fig. 9, the housing is arranged with a stop 6 which is located on two sides of the driver 2 to define two swing extreme positions of the driver 2. Alternatively or additionally, as shown in Fig. 2 and Fig. 9, it is possible to arrange a stop face 12 on the pushbutton 1 which can also limit the swing extreme position of the driver 2.

5 **[0054]** The pushbutton 1, driver 2, elastic element 4 and swing element 3 of the switch are assembled together in the state as shown in Fig. 9 so that in the natural state where the pushbutton 1 is not pressed down, the elastic element 4 abuts against the driver 2 at one end to cause it to remain in an swing extreme position at one side (the right side in Fig. 9) under constraint of the stop 6 and/or stop face 12, while the other end of the elastic element 4 forces
10 the swing element 3 to remain in the swing extreme position at the other side (namely, first position) opposite to the swing direction of the driver 2, so that the first moving contact 81 at one side of the swing element 3 (the left side of the swing element 3 in Fig. 9) is in the left swing position and contacts the first stationary contact 51 (not shown in Fig. 9) on the left side of the swing element 3, and the second moving contact 82 on the other side of the swing
15 element 3 (the right side of the swing element 3 in Fig. 9) is also in the left swing position to be disconnected from the second stationary contact 52 (not shown in Fig. 9) on the right side of the swing element 3. As such, in this state, the swing element 3 of the switch conducts the circuit (namely, a first circuit) between the moving contact wiring terminal 83, which is associated with the swing element 3 and the electrical conductive seat 84, and the first
20 stationary contact wiring terminals, which are associated with the first stationary contact 51, and meanwhile, disconnects the circuit (namely, a second circuit) between the moving contact wiring terminal 83, which is associated with the swing element 3 and the electrical conductive seat 84, and the second stationary contact wiring terminals which are associated with the second stationary contact 52. At this time, the driving face 22 of the driver 2 is distanced
25 from and does not contact the second contact face 33 on the right side of the swing element 3, or just barely contacts the second contact face 33 without applying force to the second contact face 33 and the swing element 3.

[0055] In the state shown in Fig. 9, as the driver 2 is in the swing position on the rightmost side, the driver contact face 21 on the driver 2 engages with the pushbutton contact face 11 of
30 the pushbutton 1 at its rightmost point. At this time, the connection point of the elastic element 4 and the driver 2 is on the right side of the line connecting the connection point of the elastic element 4 and the swing element 3 and the engaging point of the driver contact face 21 and the pushbutton contact face 11, while the elastic element 4, pivotally connected

between the driver 2 and the swing element 3, keeps applying recovery force to the driver 2 along the direction of the line connecting the connection point of the elastic element 4 and the swing element 3 and the connecting point of the elastic element 4 and the driver 2. Therefore, the recovery force applied by the elastic element 4 on the driver 2 will apply to the driver 2 a torque counterclockwise with respect to the engaging point of the driver contact face 21 at the rightmost side and the pushbutton contact face 11. In this way, the torque forces the driver 2 to abut against the stop 6 and/or stop face 12 so that the driver 2 remains in the swing limit position.

[0056] As shown in Fig. 10, when the button 1 is pressed, the driver 2 will move downward under the effect of pushbutton 1. As bearing the counterclockwise torque applied by the elastic element 4 and the constraint of the stop 6 and/or stop face 12, the driver 2 will not swing relative to the pushbutton 1 during the process of moving downwards, and therefore, the position of the engaging point of the driver contact face 21 and the pushbutton contact face 11 will not change but remains at the rightmost end of the driver contact face 21 and the pushbutton contact face 11. During this pressing process, when the driving face 22 of the driver 2 contacts the second contact face 33 of the swing element 3, it will continue to press the second contact face 33 to cause the swing element 3 to swing to the right side. As the driver 2 does not swing during the pressing process while the swing element 3 swings towards the right side during the pressing process, the relative posture of the driver 2 and the swing element 3 will change during the pressing process after the contact of the driver 2 and the swing element 3. Namely, the position on the second contact face 33 of the swing element 3 where the swing element 3 is pressed by the driving face 22 of the driver 2 moves gradually close to an end where the first contact face 32 and the second contact face 33 are adjacent to each other, namely, close to the center of the swing element 3.

[0057] As shown in Fig. 11, when the pushbutton 1 continues to be pressed, the swing element 3 would swing through its intermediate position relative to the housing to a swing extreme position (namely, the second position) on the side (the right side in Fig. 11) opposite to the previous side. During this process, once the swing element 3 swings to the position in which the connection point of the swing element 3 and the elastic element 4 is on the right side of the connection point of the elastic element 4 and the driver 2, the recovery force of the elastic element 4 drives the swing element 3 to swing in acceleration rightward to the swing extreme position on the right side. At this time, the second moving contact 82 on the right side of the swing element 3 contacts the second stationary contact 52 right beside the swing

element 3 to conduct the second circuit. Meanwhile, the first moving contact 81 on the left side of the swing element 3 is disconnected from the first stationary contact 51 left beside the swing element 3 to disconnect the first circuit, thereby achieving the on/off switching operation to the first circuit and the second circuit by the switch.

5 **[0058]** During the above process of pressing the pushbutton 1, with the swing of the swing element 3, the driver 2 does not swing. As a result, the position on the second contact face 33 where the second contact face 33 contacts the driving face 22 varies gradually while the length of the arm of force between the force applied by the driver 2 to the swing element 3 and the swing axis of the swing element 3 (namely, the first axis) maintains unchanged. In
10 this way, during the whole process of pressing the pushbutton 1, the driver 2 keeps driving the swing element 3 to swing for the same angle with the same unit stroke without moving away gradually from the swing axis of the swing element 3 as the swing element 3 swings, which otherwise would cause the need of a greater unit stroke for driving the swing element 3 to swing for the same angle. Thus, the driving mechanism formed by the driver 2 and the
15 swing element 3 shortens the pressing stroke of the pushbutton 1 of the switch required for the operation of switching the circuit, thus facilitating the operation of the user.

[0059] In the case that the extension direction of the first contact face 32 and the second contact face 33 from an end where the two contact faces are close to each other to a distal end is tilted toward one side of the first axis for an angle A with respect to the direction vertical to
20 the main face of the swing piece 34, with the swing of the swing element 3, the driving face 22 of the driver 2 can move faster toward the center of the swing element 3 during the process of the moving relative to the second contact face 33 of the swing element 3, which makes it possible for the driver 2 to press the swing element 3 to move for a shorter stroke in order that the swing piece 3 can swing for the same angle to reach the operating position for switching
25 on/off of the circuit. Therefore, the tilting angle further shortens the pressing stroke of the pushbutton of the switch required for the operation of switching the circuit, thereby facilitating user's operation.

[0060] In the case that the driving face 22 of the driver 2 is non-planar, particularly a convex curved face around the end of the driving arm 24, with the swing of the swing element 3,
30 during the process that the driving face 22 of the driver 2 moves relative to the second contact face 33 of the swing element 3, the part of the second contact face 33 of the swing element 3 located on the side of the driving face 22 closer to the center of the swing element 3 (the left

side of the driving face 22 in Fig. 10) contacts earlier the part of the side of the driving face 22 closer to the center of the swing element 3, which further makes it possible for the driver 2 to press the swing element 3 to move for a shorter stroke in order that the swing piece 3 can swing for the same angle to reach the operation position of switching on/off the circuit. Therefore, the non-planar driving face 22 further shortens the pressing stroke of the pushbutton 1 of the switch required for the operation of switching the circuit, thereby facilitating user's operation.

[0061] When the pushbutton 1 is released from the state shown in Fig. 11, as the swing element 3 at that time has swung to the swing extreme position on the right side, namely, the connection point between the elastic element 4 and the swing element 3 has tilted to the other side (the right side in Fig. 11) of the swing element 3, the connection point of the elastic element 4 and the driver 2 becomes located on the left side of the line connecting the connection point of the elastic element 4 and the swing element 3 and the engaging point of the driver contact face 21 and the pushbutton contact face 11. Therefore, the recovery force applied by the elastic element 4 on the driver 2 will apply on the driver 2 a torque clockwise with respect to the engaging point of the driver contact face 21 on the rightmost side and the pushbutton contact face 11. The clockwise torque drives the driver contact face 21 of the driver 2 to "roll" along the pushbutton contact face 11 of the pushbutton 1 to cause the driver 2 to swing to the left side, as shown in Fig. 12. During this "rolling" process, the engaging point between the driver contact face 21 and the pushbutton contact face 11 will move gradually to the left.

[0062] Even when the driver 2 swings to the intermediate position with respect to the housing as shown in Fig. 12, namely, when both the engaging point of the driver contact face 21 and the pushbutton contact face 11 and the connection point of the driver 2 and the elastic element 4 are in the intermediate position with respect to the housing, as the connection point of the swing element 3 and the elastic element 4 remains on the right side as a result of the swing element 3 staying in the swing extreme position to the right, the connection point of the elastic element 4 and the driver 2 is still on the left side of the line connecting the connection point of the elastic element 4 and the swing element 3 and the engaging point of the driver contact face 21 and the pushbutton contact face 11. Therefore, the recovery force applied by the elastic element 4 on the driver 2 will still apply on the driver 2 a torque clockwise with respect to the engaging point of the driver contact face 21 in the intermediate position and the pushbutton contact face 11 so that the driver 2 continues to swing to the left and pass through

the swing axis (namely, the first axis) of the swing element 2 until the driver 2 abuts against the stop 6 and/or stop face 12 on the left side of the swing axis of the swing element 2 and forces the driver 2 to remain in the swing extreme position, as shown in Fig. 13. At this time, the engaging point of the driver contact face 21 and the pushbutton contact face 11 has moved to the leftmost side of the driver contact face 21 and the pushbutton contact face 11.

[0063] In the above swing process of the driver 2, as the pushbutton 1 has been released, the recovery force of the elastic element 4, while driving the driver 2 to swing, further drives the driver 2 and pushbutton 1 to move upwards together away from the swing element 3. Therefore, during the swing process of the driver 2, the driver 2 does not contact and press the swing element 3 anymore. In other words, during the swing process of the driver 2, the movement of the driver 2 will not be affected by the swing element 3. Meanwhile, the swing element 3 will also always remain in the extreme swing position to the right under the elastic recovery force of the elastic element 4 and keep the operation state of disconnecting the first circuit and conducting the second circuit. The driver 2 will also stay in the swing extreme position on the leftmost side under the constraint of the stop 6 and/or stop face 12 and the effect of the recovery force of the elastic element 4. In this manner, the resetting action of the pushbutton 1 is completed and the driver 2 is also ready for the next press operation of the pushbutton 1.

[0064] When the pushbutton 1 is pressed again, the driver 2 will be driven by the pushbutton 1 to move downwards to contact and press the first contact face 32 on the left side of the swing element 3 to cause the swing element 3 to swing to the left side. Meanwhile, the driver 2 remains not swinging relative to the pushbutton 1 so that the first moving contact 81 on the left side of the swing element 3 contacts the first stationary contact 51 again while the second moving contact 82 on the right side of the swing element 3 is disconnected again from the second stationary contact 52. In this way, the switch conducts the first circuit again and disconnects the second circuit, thereby achieving again the on/off switching operation by the switch for the first circuit and the second circuit. During this pressing process, the driving face 22 of the driver 2 will also move relative to the first contact face 32 of the swing element 3 gradually close to the center of the swing element 3, and similar to the case when the driving face 22 drives the second contact face 33, the effect of shortening the stroke of the driver 2 is also achieved.

[0065] When the pushbutton 1 is released again, the driver 2 will swing to the swing extreme

position on the rightmost side again according to a process similar to that described with reference to Figs. 11-13, and meanwhile, the engaging point of the driver contact face 21 and the pushbutton contact face 11 also changes to the rightmost end of the driver contact face 21 and the pushbutton contact face 11 again to be ready for the driver 2 to drive the swing element 3 to act and the driver 2 to swing for resetting for the next time.

[0066] In the embodiments of the switch described above, as the driver 2 does not swing or rotate during the process of driving the swing element 3, the distance between the driver 2 and the swing axis of the swing element 3 remains unchanged. Therefore, the driver 2 can drive the swing element 3 to swing for the same angle with a constant unit stroke, thereby making the stroke of driver 2 (and the stroke of the pushbutton 1) even smaller. Thus, the user can operate the pushbutton 1 more easily to achieve reliable switching operation of the switch. Furthermore, since the deciding factor for the driver 2 to drive the swing element 3 to swing in place is the distance between the driver 2 and the swing axis of the swing element 3, it is possible that by means of simply arranging the distance between the driver 2 and the swing axis of the swing element 3, the switch can obtain the expected strokes of the driver 2 and pushbutton 1. For example, by configuring this distance small enough, the stroke of the driver 2 and pushbutton 1 can be smaller.

[0067] In the embodiments of the switch described above, the direction of the force applied by the driver 2 on the swing element 3 is substantially the same as the direction of the force for pressing the pushbutton 1. Hence, the majority of the force from the user for pressing the pushbutton 1 can be converted directly into effective force for the driver 2 to drive the swing element 3 to act to switch the position of the moving contact. Thus, the switch exhibits high converting efficiency of the force, thereby lowering the requirement on the force from the user for pressing the pushbutton 1.

[0068] In addition, by directly arranging the moving contact on the swing element 3, the swing element 3 serves not only as the actuator for receiving driving of the driver 2 but also as a switch bridge for directly driving the moving contact to act, which not only enables less number of components in the switch but also makes it possible to apply the driving force from the driver 2 directly on the moving contact without being converted by other components. Thus, the driving force of the driver 2 can drive the moving contact to act with higher efficiency and meanwhile, the acting mechanism of the switch is less sensitive to the dimension and the operation of the switch can be more reliable.

[0069] In the embodiments of the switch described above, by connecting the elastic element 4 between the driver 2 and the swing element 3, the same elastic element 4 can drive the swing element 3 to swing to the swing extreme position with greater speed to achieve on/off switching operation on the circuit as quickly as possible, and during the resetting process of the driver 2, provide supporting force to the swing element constantly to keep the swing element 3 in the swing extreme position so as to maintain reliable conduction or disconnection position of the corresponding moving contact and stationary contact. Meanwhile, the same elastic element 4 can also drives the driver 2 to reset, thereby avoiding the use of two different elastic elements to achieve the above two functions respectively. In this way, the number of components in the switch can be reduced and thus, the structure of the switch can be simplified. Besides, when the pushbutton 1 is pressed to the bottom, the elastic element 4 is compressed to the greatest extent, so that the elastic element 4 provides the largest contact force for the moving contact, which enables the moving contact to contact the stationary contact more reliably during the contact and reduces the bounce of the moving contact generated when engaging with the stationary contact.

[0070] In the embodiments of the switch described above, the driver 2 does not swing during the operation process of driving the swing element 3, and during the resetting process of the driver 2, it is directly reset to the swing extreme position where the driver 2 will drive the swing element 3 for the next time. Thus, the driver 2 remains in the swing extreme position where it is ready to press the swing element 3 all the time in the natural state of the switch with the pushbutton 1 being not pressed and there is no intermediate position. Therefore, the driver 2 can accurately drive the swing element 3 to act each time to achieve the operation of the switch for switching the circuit smoothly, precluding the misgiving that the driver 2 cannot accurately reach the predefined position for driving the swing element 3 from its intermediate position during each pressing process.

[0071] In the embodiments of the switch described above, by defining two swing extreme positions of the driver 2 with the stop 6 on the housing and/or the stop face 12 on the pushbutton 1, the position where the driver 2 presses the swing element 3 can be controlled accurately by simply controlling the position of the stop 6 and/or stop face 12 on the housing and/or pushbutton 1, which also facilitates obtaining greater symmetry of the respective driving positions for the driver 2 on two sides of the swing element 3.

[0072] In the embodiments of the switch described above, since the driver 2 achieves swing

support of the driver 2 by engagement between the driver contact face 21 and the pushbutton contact face 11 of the pushbutton 1, and the engaging point between the driver contact face 21 and the pushbutton contact face 11 varies during the swing process of the driver, during the resetting process of the driver 2, the elastic element 4 can not only reset it to the rightmost swing extreme position when the driver 2 is at its leftmost swing extreme position so as to be ready for the next driving action but also reset it to the leftmost swing extreme position when the driver 2 is at its rightmost swing extreme position so as to be ready for the next driving action. Meanwhile, the engagement between the driver contact face 21 and the pushbutton contact face 11 also causes the rotation radius of the driving face 22 of the driver 2 to increase to exceed the distance between the driving face 22 and the connection point of the driver 2 and the pushbutton 1, thereby achieving greater swing amplitude of the driver 2 in a compact inner space of the switch, which also reduces the stroke of the driver 2 and the pushbutton 1 and the size of the switch.

[0073] In the embodiments of the switch described above, as the converting efficiency from the force for pressing the pushbutton 1 to the force for driving the moving contact to act is improved, and moreover, and there is no other mechanism which brings remarkably increased resistance to the movement of the driver 2, as compared to the traditional switch, the switch according to these embodiments does not have significantly greater requirement on the pressing force for pressing the pushbutton 1 during operating the switch.

[0074] Variations can also be made on the basis of the switch according to the first embodiment of the present invention as described above to achieve at least a part of the various advantageous technical effects of the first embodiment according to the present invention.

[0075] In a second embodiment shown in Fig. 14, the switch differs from the switch in the first embodiment in that the swing element 3 only serves as the actuator for receiving the driving from the driver 2. The swing element 3 is not arranged with a moving contact but only has a driving head 37 on the lower end. Between the first contact face 32 and the second contact face 33 of the swing element 3 and the driving head 37, there is arranged a swing shaft 38 which is rotatably supported on the housing. The switch is further arranged with a separate switch bridge 7 which is made of electrically conductive material with two ends serving as the first moving contact 81 and the second moving contact 82, respectively. The center of one side of the switch bridge 7 is swingingly supported on the electrically

conductive seat 84 electrically connected to the wiring terminal 83 of the moving contact and the driving head 37 of the swing element 3 contacts the other side of the switch bridge 7. When the pushbutton 1 is pressed, the driver 2 drives the swing element 3 to swing to two different swing extreme positions (namely, the first position and the second position) in the same manner as in the first embodiment, and the driving head 37 on the swing element 3 would press the side of the switch bridge 7 the same as the swing direction of the driving head 37 of the swing element 3 (namely, the side opposite to the swing direction of the first contact face 32 and the second contact face 33 of the swing piece), so that the first contact 81 or the second contact 82 of the switch bridge 7 on the end of this side contacts the corresponding first stationary contact 51 or second stationary contact 52 and meanwhile, the second moving contact 82 or the first moving contact 81 on the other end of the switch bridge 7 is disconnected from the corresponding stationary contact, thereby achieving the operation of the switch for switching the on/off state of the circuit. In this embodiment, as the switch bridge 7 located below the swing axis of the swing element 3 is introduced, the order for the swing element 3 to drive the moving contact to conduct and disconnect the first circuit and second circuit is contrary to that depicted in the first embodiment. When the pushbutton 1 is released, the driver 2 is driven by the elastic element 4 in the same manner as depicted in the first embodiment to swing to the other swing extreme position and thus gets reset.

[0076] In the third embodiment shown in Fig. 15, the switch differs from the switch according to the first embodiment in that the driver 2 has a planar driving face 22', and instead of having the first contact face 32 and the second contact face 33 on the swing element 3, the swing element 3 is provided with a first contact point 36 and a second contact point 37 located on two sides of the swing axis (first axis). When the pushbutton 1 is pressed, the driving face 22' of driver 2 does not swing either, but moves linearly along with the pushbutton 1 to press one of the first contact point 36 and the second contact point 37 to cause the swing element 3 to swing so that the moving contact on the swing element 3 contacts or is disconnected from the first stationary contact 51 and the second stationary contact 52 respectively. During this pressing process, the position on the driving face 22' pressing the first contact point 36 or the second contact point 37 moves gradually close to the edge of the driving face 22'. In other words, similar to the first embodiment, during the pressing process, the contact point between the driver 2 and the swing element 3 also keeps varying, and the distance between the force applying point from the driver 2 to the swing element 3 and the swing axis (the first axis) of the swing element 3 also remains unchanged. When the pushbutton 1 is released, the driver

2 is driven by the elastic element 4 in the same manner as in the first embodiment to swing to the other swing extreme position and thus gets reset.

[0077] In the fourth embodiment shown in Fig. 16-Fig. 17, the switch differs from the switch in the first embodiment in that the driver 2 is pivotally mounted on the pushbutton 1 through a pivot 25 and a contact rib 26 is provided on the lower side of the driver 2. The swing element 3 has a fastening post 38 at one end and a driving lever 39 at the other end. The elastic element 4 is mounted on the fastening post 38 at one end to be fixedly connected to the swing element 3 and abuts against the contact rib 26 of the driver 2 at the other end. The driving lever 39 of the swing element 3 is coupled to the switch bridge 7. The first moving contact 81 and the second moving contact 82 are located on two sides of the switch bridge 7, rather than on the swing element 3. When the pushbutton 1 is pressed, the pushbutton 1 drives the driver 2 to move downwards. However, the driver 2 does not swing or rotate either. The driver 2 drives the first contact face 32 and the second contact face 33 of the swing element 3 in the same manner as depicted in the first embodiment to cause the swing element 3 to swing to the swing extreme position, so that the driving lever 39 on the swing element 3 drives the switch bridge 7 to cause the first moving contact 81 or second moving contact 82 on the switch bridge 7 to contact or disconnect from the corresponding stationary contact. When the pushbutton 1 is released, the elastic element 4 will push the driver 2 to move upwards. At this time, as the elastic element 4 abuts against and contacts the contact rib 26 of the driver 2 and the driver 2 is still in the swing extreme position when the pushbutton 1 is just released, the contact rib 26 is tilted relative to the end of the elastic element 4. As a result, the elastic element 4 applies a recovery force on the driver 2 only at one end of the contact rib 26. Furthermore, since the swing direction of the swing element 3 is the same as that of the driver 2 when the pushbutton 1 is just released (see Fig. 11), the elastic element 4 will apply a recovery force on the driver 2 at a lower end of the contact rib 26 so that the driver 2 rotates to the swing extreme position on the other side, thereby completing resetting. In this embodiment, it is also possible not to arrange the switch bridge 7 but only to configure the moving contact directly on the swing element 3, as in the first embodiment.

[0078] It should be appreciated that although the switch according to the above embodiments can connect two paths of circuits and alternative on/off switching operation of these two paths of circuits can be achieved with the operation of the switch, it is also possible for the switch to connect only one of the first stationary contact 51 and the second stationary contact 52 with a

path of circuit while the other one of the first stationary contact 51 and the second stationary contact 52 does not connect with a circuit. In this manner, each pressing operation of the switch only conducts or disconnects this one path of circuit. Furthermore, the switch according to the above embodiments can provide only one moving contact and one stationary contact so that the switch can only conduct or disconnect a path of circuit by each pressing operation.

[0079] It should be appreciated that for the ease of depiction, the placing location of the switch is illustrated in the text based on the drawings. Directions “up, down, left, right” in the text are all described based on this orientation. Obviously, the switch can be arranged in various directions as required. The directional depiction about “up, down, left, right” among features described in the text will change accordingly with the change of orientation of location of the switch. However, the relative positional relation between the features will not change.

[0080] The specification of the present disclosure has been presented for purposes of illustration, but is not intended to be exhaustive or limited to the embodiments disclosed. Many modifications and variations will be apparent to those skilled in the art

[0081] Therefore, the embodiments are selected and depicted to better illustrate the principles and practical applications of the present disclosure and to enable others of those skilled in the art to understand the following content, namely, without departing from the spirit of the present disclosure, various modifications and variations shall fall under the scope of protection of the present disclosure.

What is claimed is:

1. A switch, comprising:

a pushbutton (1) having a pushbutton contact face (11);

5 a driver (2) having a driver contact face (21);

a swing element (3) that can swing with respect to a first axis;

an elastic element (4) connected between the driver (2) and the swing element (3) and causing the driver contact face (21) of the driver (2) to abut against the pushbutton contact face (11) of the pushbutton (1); and

10 a first moving contact (81) and a first stationary contact (51);

wherein the driver (2) is configured such that when the pushbutton (1) is pressed down, the driver (2) at its first swing limit position drives the swing element (3) to swing to a first position, and when the pushbutton (1) is released, the elastic element (4) drives the driver (2) to swing relative to the pushbutton (1) to its second swing limit position, and when
15 the pushbutton (1) is pressed down again, the driver (2) in its second swing limit position drives the swing element (3) to swing to a second position; and in one of the first position and the second position, the first moving contact (81) contacts the first stationary contact (51) while in the other one of the first position and the second position, the first moving contact (81) is disconnected from the first stationary contact (51),

20 characterized in that

the driver contact face (21) and the pushbutton contact face (11) are arranged with teeth engaging with each other.

2. The switch according to Claim 1, wherein during the swing process of the driver
25 (2), the engaging point between the driver contact face (21) of the driver (2) and the pushbutton contact face (11) of the pushbutton (1) varies.

3. The switch according to one of Claims 1-2, wherein the driver contact face (21) and the pushbutton contact face (11) are configured with a sufficient friction coefficient to
30 prevent producing relative sliding between the driver contact face (21) and the pushbutton contact face (11) during the swing process of the driver contact face (21) relative to the pushbutton contact face (11).

4. The switch according to one of Claims 1-2, wherein the switch further comprises a housing in which a stop (6) is arranged, the stop (6) defining the first swing limit position and the second swing limit position of the driver (2).

5 5. The switch according to one of Claims 1-2, wherein there is arranged a stop face (12) on the pushbutton (1), the stop face (12) defining the first swing limit position and second swing limit position of the driver (2).

10 6. The switch according to one of Claims 1-2, wherein the elastic element (4) is pivotally connected between the driver (2) and the swing element (3).

7. The switch according to one of Claims 1-2, wherein the driver (2) is configured such that during the process of the driver (2) pressing the swing element (3) to cause it to swing, the driver (2) does not swing relative to the pushbutton (1) so that, during the process
15 of the driver (2) pressing the swing element (3), the contact position between the driver (2) and the swing element (3) changes.

8. The switch according to Claim 7, wherein the swing element (3) comprises a swing piece (34) on which the first moving contact (81) is located and a driving arm (35) the
20 longitudinal direction of which is vertical to the swing piece (34), a first contact face (32) and a second contact face (33) extending on the driving arm (35) and being distributed symmetrically about the first axis; the driver (2) has a driving face (22) for pressing the first contact face (32) and the second contact face (33), and the driver (2) is configured such that
25 when the pushbutton (1) is pressed down, the driving face (22) presses one of the first contact face (32) and the second contact face (33) to cause the swing element (3) to swing, and the position on the first contact face (32) or the second contact face (33) of the swing element (3) where the swing element (3) is pressed by the driving face (22) moves gradually close to an end of the first contact face (32) and the second contact face (33) adjacent to each other.

30 9. The switch according to Claim 7, wherein the switch further comprises a switch bridge (7) on which the first moving contact (81) is located, the swing element (3) cooperating with the switch bridge (7); the first contact face (32) and the second contact face (33) extend on the driving arm (35) and are distributed symmetrically about the first axis; the driver (2) has a driving face (22) for pressing one of the first contact face (32) and the second

contact face (33), and the driver (2) is configured such that when the pushbutton (1) is pressed down, the driving face (22) presses one of the first contact face (32) and the second contact face (33) to cause the swing element (3) to swing so that the swing element (3) drives the switch bridge (7) to swing to the position where the first moving contact (81) is in contact with or disconnected from the first stationary contact (51), and the position on the first contact face (32) or the second contact face (33) of the swing element (3) where the swing element (3) is pressed by the driving face (22) moves gradually close to an end of the first contact face (32) and the second contact face (33) adjacent to each other.

10. The switch according to Claim 8 or Claim 9, wherein the extension directions of the first contact face (32) and the second contact face (33) from the ends of the first and second contact faces close to each other to the distal ends thereof are tilted with an angle (A) towards one side of the first axis with respect to the direction vertical to the main face of the swing piece (34), wherein the angle is in particular between 0 degree and 20 degrees.

11. The switch according to Claim 7, wherein the driver (2) has a planar driving face (22') and the swing element (3) is provided with a first contact point (36) and a second contact point (37), the driver (2) being configured such that when the pushbutton (1) is pressed down, the driving face (22') presses one of the first contact face (36) and the second contact face (37) to cause the swing element (3) to swing, and the position on the driving face (22') pressing the first contact point (36) or the second contact point (37) moves gradually close to the edge of the driving face (22').

12. The switch according to one of Claims 1-2, wherein the switch further comprises a second moving contact (82) and a second stationary contact (52); in one of the first position and the second position of the swing element (3), the first moving contact (81) contacts the first stationary contact (51) and the second moving contact (82) is disconnected from the second stationary contact (52), while in the other one of the first position and the second position, the first moving contact (81) is disconnected from the first stationary contact (51) and the second moving contact (82) contacts the second stationary contact (52).