

Microswitch

The invention relates to a microswitch with at least two contact points with one movable contact and one fixed contact each, wherein the movable contacts are arranged on a contact bridge, the contact bridge is movable by means of a plunger and can be transferred from a first switching position in which the contact points are open to a second switching position in which the contact points are closed.

Such microswitches have been in use for quite a long time and are employed in applications with low currents, for example control currents or fault currents, in the milliampere range. It is known that the contacts of these microswitches can become dirty in use, so that in the worst case there is no more current flow between the contacts in the closed position.

It is therefore known to mount the contact bridge via springs at the switch plunger of the microswitch, so that during switching a relative movement between the movable contacts and the fixed contacts can occur, whereby dirt at the contacts is removed.

The contact bridge is floatingly mounted in the plunger via the spring. Thereby, the position of the contact bridge as well as the force transmitted during switching, i.e. during the closing and opening of the contact points, is not clearly defined. The motion sequence at the opposing contacts of the contact points during opening and closing is neither determined.

It is therefore the object of the present invention to provide an improved microswitch by means of which a reliable self-cleaning of the contacts during closing or switching, respectively, is achieved.

For this, it is provided according to the invention that the contact bridge is mounted such that the contact bridge performs a rotary motion about an axis of rotation extending in parallel to its longitudinal extension during closing and opening of the contacts, whereby a forced frictional movement transversely with respect to the longitudinal extension of the contact bridge is performed between the opposing contacts of each contact point.

By the mounting of the contact bridge, the rotary motion of the contact bridge during opening and closing is determined. Therefore, the movable contacts are guided on the same circular

path in each switching operation, whereby the frictional movement between the movable contacts and the fixed contacts always follows essentially the same path, transverse with respect to the longitudinal extension of the contact bridge, and is thus forced. That means, with each switching operation, an essentially identical movement occurs at the contact points. By the fact that a frictional movement transverse with respect to the longitudinal extension of the contact bridge is performed during switching, the opposing contacts are furthermore firmly wiped past each other, so that dirt is reliably rubbed or wiped out of the contact points and current flow is ensured in the closed position.

In a preferred embodiment, it is provided that the plunger comprises an upper bearing against which the contact bridge lies in the closed position, and a lower bearing against which the contact bridge lies in the open position, where the upper bearing is arranged diagonally with respect to the lower bearing. That means, at a movement of the plunger, the contact bridge is thus transferred from a position in which the contact bridge is arranged essentially perpendicularly with respect to the plunger to a position in which the contact bridge is arranged diagonally with respect to the plunger. Thereby, the rotary or tilting motion is generated which is required for the contacts to rub each other transversely with respect to the longitudinal extension of the contact bridge. In addition, it can be ensured that sufficient pressure for the self-cleaning of the contacts is generated with the plunger movement.

Another variant provides for the contact bridge to comprise at least one first lever arranged transversely with respect to the longitudinal extension of the contact bridge which is mounted in a seat in the plunger. The contact bridge is thus in a defined way mounted at one point in the seat of the plunger, a defined center of rotation for the rotary motion of the contact bridge is formed by which the frictional movement transverse with respect to the longitudinal extension of the contact bridge is generated at the contacts. By means of the distance of the center of rotation from the contact points, the amount of frictional movement between the contacts can be adjusted. Here, the frictional movement should not be too large, as otherwise excessive friction and thus excessive wear occurs at the contacts.

Preferably, the first lever is arranged centrically between the two movable contacts at the contact bridge. Thus, it can be ensured that approximately the same forces act at both contact points.

Another preferred embodiment provides for the contact bridge to comprise a further lever which is arranged opposite to the first lever and is guided in a guide in the plunger. Thereby, a centering of the contact bridge can be achieved during closing and opening of the contacts.

In an advantageous embodiment, it can be provided that the contact bridge is rotatably mounted about an axis extending transversely with respect to the longitudinal axis of the plunger and transversely with respect to the longitudinal extension of the contact bridge. Thereby, the contact bridge can perform a rocking movement whereby vertical inaccuracies between the two contact points can be evened out. If the two fixed contacts are not arranged at the same level, this is evened out.

Conveniently, the contact bridge is also rotatably mounted about the longitudinal axis of the plunger. This permits a rotary motion of the contact bridge, whereby a horizontal misalignment of the two fixed contacts with respect to each other can be evened out.

An advantageous embodiment provides for the upper bearing of the plunger to comprise a rounded contact surface for the contact bridge. Thereby, the rocking and rotary motions are facilitated by which slight misalignments of the two fixed contacts with respect to each other are evened out.

In one variant, the microswitch can comprise at least one further contact bridge which is designed and mounted essentially identically to the first contact bridge. In this manner, a switch with double-break and galvanic isolation can be realized.

Here, it can be provided that each of the contact bridges is supported at the plunger in the longitudinal direction of the plunger by means of a spring, where one end of the spring is connected to the contact bridge and the other end of the spring is arranged in a seat in the plunger. If the distance of the contact bridges at the plunger does not exactly correspond to the distance of the pairs of fixed contacts in the housing, these differences can be evened out by the resilient mounting.

Another convenient embodiment provides for a centering projection for the spring to be

provided on each contact bridge. Thereby, easy mounting of the spring at the contact bridge is possible.

In one convenient embodiment, the fixed contacts can have an essentially V-shaped cross-section, and the movable contacts can have an essentially semicircular cross-section. Thereby, the frictional movement in the longitudinal direction of the contact bridge is supported during the closing of the contacts, effective self-cleaning of the contacts is performed.

Another embodiment provides for the microswitch to comprise a housing and the plunger to be guided in the housing, where the housing comprises a centering part which guides a centering element of the plunger. Thereby, the plunger is held in the housing on the desired motion path.

Below, embodiments of the invention will be illustrated more in detail by means of a drawing. The drawings show:

Fig. 1 a plan view of an opened microswitch with two contact bridges in the open position,

Fig. 2 a plan view of an opened microswitch with two contact bridges in an intermediate position during the closing operation,

Fig. 3 a plan view of an opened microswitch with two contact bridges in the closed position,

Fig. 4 a side view of the plunger of the microswitch with two contact bridges arranged therein,

Fig. 5 a plan view of a partially sectional view of the plunger with two contact bridges arranged therein,

Fig. 6 a plan view of a contact bridge, and

Fig. 7 a side view of a contact bridge.

Fig. 1 shows a plan view of a microswitch 1, wherein the housing cover of the microswitch 1 has been removed. The microswitch 1 comprises a housing 2 in which a plunger 3 is arranged. Two contact bridges 4, 5 are mounted in the plunger 3. Two movable contacts 6.1, 6.2; 7.1, 7.2 are arranged on each of the contact bridges 4, 5. The movable contacts 6.1, 6.2; 7.1, 7.2 each cooperate with fixed contacts 8.1, 8.2; 9.1, 9.2, where the fixed contacts 8.1, 8.2; 9.1, 9.2 are arranged in the housing 2. That means, the movable contacts 6.1, 6.2; 7.1, 7.2 arranged on the contact bridges 4, 5 form two corresponding contact points 10.1, 10.2; 11.1, 11.2 each with the respective opposing fixed contacts 8.1, 8.2; 9.1, 9.2. That means, the microswitch 1 comprises two double-breaks, whereby a galvanic isolation is realized and various electric circuits or load and control currents, respectively, can be switched. By the double-break, the voltage applied to the switch is distributed to two fixed contacts. Thereby, in contrast to a single-break, higher voltages and powers can be applied with the same contact distance. Longer electric service life and higher contact reliability are realized.

The plunger 3 is guided in the housing 2 in a guide 12 and can be transferred from a first position, in which the contact points 10.1, 10.2, 11.1, 11.2 are opened to a second position in which the contact points 10.1, 10.2, 11.1, 11.2 are closed. In Fig. 1, the plunger 3 is represented in the first position with opened contact points 10.1, 10.2, 11.1, 11.2. The housing 2 further comprises a centering part 13 which cooperates with a centering element 14 arranged at the plunger 3 and centers the plunger 3 in the guide 12. For this, the centering part 13 and the centering element 14 comprise beveled contact surfaces which lie against one another in the open position of the contact points 10.1, 10.2, 11.1, 11.2 and position the plunger 3 centrically in the guide 12.

In Fig. 2, a microswitch 1 is also shown without cover, the plunger 3 is in an intermediate position during the closing operation. The actuation of the plunger 3 for transferring the contact points 10.1, 10.2, 11.1, 11.2 from the open position to a closed position can be accomplished via a snap element, for example a bistable spring (not represented). However, other actuating mechanisms are also conceivable.

In the position shown in Fig. 2, the movable contacts 6.1, 6.2, 7.1, 7.2 arranged on the contact bridges 4, 5 are already arranged very close to the respective opposing fixed contacts 8.1, 8.2, 9.1, 9.2, however they are not yet in the end position or closed position,

respectively. The plunger 3 was moved away from the centering part 13 of the housing 2 by actuation of the snap element, so that the centering part 13 of the housing and the centering element 14 of the plunger 3 do no longer touch each other. The contact bridges 4, 5 are still arranged essentially perpendicularly to the plunger 3.

In Fig. 3, the microswitch 1 is represented in the closed position of the contact points 10.1, 10.2; 11.1, 11.2. By the operating element (not represented), the plunger 3 was moved to the position in which the centering part 13 and the centering element 14 are furthest apart. The switching force exerted on the plunger 3 by the operating element is transmitted to the contact bridges 4, 5, so that the movable contacts 6.1, 6.2; 7.1, 7.2 are pressed to the fixed contacts 8.1, 8.2; 9.1, 9.2 with maximum switching force. The contact points 10.1, 10.2; 11.1, 11.2 are thus in the closed position. In the closed position, the contact bridges 4, 5 are arranged diagonally to the plunger 3.

In Fig. 4, a side view of the plunger 3 with the contact bridges 4, 5 mounted therein is represented. In the shown position, the contact bridges 4, 5 are in an open position of the contact points. In this open position of the contact points, the contact bridges 4, 5 are each lying against a lower bearing 15, 16 of the plunger 3. Furthermore, one upper bearing 17, 18 each is arranged in the plunger 3 adjacent to each contact bridge 4, 5. Each of the upper bearings 17, 18 is arranged diagonally with respect to the corresponding lower bearing 15, 16.

In the closed position of the contact points, each of the contact bridges 4, 5 lies against the respective upper bearing 17, 18 and thus assumes a diagonal position with respect to the open position. That means, opening planes spanned by the contact bridges 4, 5 in the open position enclose an angle with closing planes spanned by the contact bridges 4, 5 in the closed state.

Each of the contact bridges 4, 5 furthermore comprises a lever 19, 20 at one of its longitudinal sides which is received each in a seat 21, 22 arranged in the plunger 3.

Furthermore, at each of the contact bridges 4, 5, a further lever 23, 24 is arranged at the longitudinal side opposite the respective lever 19, 20. The levers 23, 24 are each guided in a guide 25, 26 of the plunger 3, where the guides 25, 26 have a length which is larger than the

width of the levers 23, 24, so that these levers 23, 24 can slide along in these guides 25, 26 when the contact bridges 4, 5 are being transferred from the open position to the closed position. Thereby, a centering of the contact bridges 4, 5 in the plunger 3 is achieved.

In Fig. 5, a partially sectional view of the plunger 3 is shown. In Fig. 5, the contact bridges 4, 5 are also shown in the open position. The contact bridges 4, 5 here lie against the respective lower bearings 15, 16. As is shown, the upper bearings 17, 18 extend diagonally with respect to the lower bearings 15, 16, so that the contact bridges 4, 5 perform a tilting motion when they are transferred from the open position to the closed position. The surface of the upper bearings 17, 18 is furthermore rounded, so that a rotary motion of the contact bridges 4, 5 about the longitudinal axis of the plunger and a rocking motion of the contact bridges 4, 5 about an axis transverse to the longitudinal axis of the plunger and transverse to the longitudinal axis of the contact bridges 4, 5 is also possible.

Each of the contact bridges 4, 5 is mounted in the plunger 3 via a spring 27, 28. Each of the springs 27, 28 is fixed with one end on a centering projection 29, 30 of the contact bridges 4, 5. The respective other end of the springs 27, 28 is received in a recess 31, 32 which is arranged in the plunger 3. Thereby, the springs 27, 28 are guided in the respective recess 31, 32 during the closing operation of the microswitch 1. By the springs 27, 28, deviations of the distance of the contact bridges 4, 5 to each other and the distance of the pairs of fixed contacts 8.1, 8.2; 9.1, 9.2 to each other arranged in the housing 2 can be evened out.

Fig. 6 shows a plan view of the contact bridge 4. The other contact bridge 5 is designed identically to this contact bridge 4, therefore, the description applies to both contact bridges.

On the upper side of the contact bridge 4, the centering projection 29 for the spring 27 is arranged centrically. The first lever 19 is arranged at the lower longitudinal side 33 of the contact bridge 4. This lever 19 is located preferably centrically between the two movable contacts 6.1, 6.2. The switching force transmitted to the contact bridge 4 by the plunger 3 during the switching of the microswitch 1 is evenly transmitted to both contact points 10.1, 10.2 by this arrangement of the lever 19. As already described, the lever 19 is arranged in a seat 21 in the plunger 3. The second lever 23 is arranged at the longitudinal side 34 of the contact bridge 4 opposite to the lever 19, this lever 23 being received in a guide 25 in the plunger 3 and serves to center the contact bridge 4.

Fig. 7 shows a side view of the contact bridge 4. Here, too, the centering projection 29 and the upper lever 23 can be seen. On the bottom side of the contact bridge 4, the movable contacts 6.1, 6.2 are arranged.

Below, the functional principle of the microswitch is now illustrated with reference to the figures.

As already described, the microswitch 1 comprises an operating element (not represented), preferably a bistable spring, by which the plunger 3 can be transferred from a first position, the open position of the microswitch 1, to a second position, the closed position of the microswitch 1. In the open position of the microswitch 1, which is represented in Fig. 1, the movable contacts 6.1, 6.2, 7.1, 7.2 arranged on the contact bridges 4, 5 are separate from the fixed contacts 8.1, 8.2, 9.1, 9.2 arranged in the housing 2, so that there is an air gap between them. That means, the contact points 10.1, 10.2, 11.1, 11.2 are open. Each of the contact bridges 4, 5 lies against the respective lower bearing 15, 16 of the plunger 3. If the operating element is actuated, a switching force is transmitted to the plunger 3 and the plunger 3 is moved in the guide 12, so that the microswitch 1 is transferred to the closed position. The closed position is shown in Fig. 3. In the closed position of the microswitch 1, the contact points 10.1, 10.2, 11.1, 11.2 are closed, the movable contacts 6.1, 6.2, 7.1, 7.2 arranged on the contact bridges 4, 5 firmly lie against the opposing fixed contacts 8.1, 8.2, 9.1, 9.2. The contact bridges 4, 5 now lie against the upper bearings 17, 18 of the plunger 3. As the surface of the upper bearings 17, 18 is diagonally opposite the surface of the lower bearings 15, 16, now the contact bridges 4, 5 also lie diagonally in the microswitch 1.

During the transfer of the contact bridges 4, 5 from the open position to the closed position, the contact bridges 4, 5 first perform a translatory motion together with the plunger 3 until the movable contacts 6.1, 6.2; 7.1, 7.2 lie against the respective opposing fixed contacts 8.1, 8.2; 9.1, 9.2. If this is the case, the contact bridges 4, 5 can no longer be translatorily moved. The plunger 3, however, is not yet in its end position and is further moved translatorily. The contact bridges 4, 5 are now rotated, where the respective center of rotation is the lower end of the respective first lever 19, 20 of the contact bridges 4, 5. That means, rotation is performed essentially about an axis of rotation extending in parallel to the longitudinal extension of the contact bridges 4, 5. By the length of this lever 19, 20, and thus

by the distance of the center of rotation from the contact points 10.1, 10.2; 11.1, 11.2, the extent of the rotary motion can be determined. The contact bridges 4, 5 are rotated until they lie against the respective upper bearings 17, 18 of the plunger 3. By this rotary motion of the contact bridges 4, 5, a frictional movement is generated in the contact points 10.1, 10.2, 11.1, 11.2 which takes place transversely to the longitudinal extension of the contact bridges. As each contact bridge 4, 5 is mounted via the respective first lever 19, 20 at a defined point, the respective seat 21, 22 in the plunger 3, the rotary motion of the contact bridges 4, 5 is determined. Thus, the frictional movement at the contact points 10.1, 10.2, 11.1, 11.2 is also determined or forced, respectively. By this forced frictional movement, dirt possibly located in the contact points 10.1, 10.2, 11.1, 11.2 is removed, possibly dirty contacts are cleaned, and reliable current flow takes place in the closed position of the microswitch 1.

To permit centering of the contact bridges 4, 5 during this rotary motion, a second lever 23, 24 each is provided at the contact bridges 4, 5 which is each guided in a guide 25, 26 in the plunger 3 and translatorily moves in this guide 26 during the rotary motion of the contact bridges 4, 5.

The first levers 19, 20 of the contact bridges 4, 5 are preferably arranged centrically between the movable contacts 6.1, 6.2; 7.1, 7.2 arranged on the contact bridges. It can thus be ensured that approximately the same forces act at both contact points and thus an equal frictional movement occurs. As was already described, the amount of friction force acting at the contact points can be adjusted by means of the length of these levers 19, 20. Here, it has to be taken care that the friction force does not get too large as due to excessive friction, excessive wear occurs at the movable contacts 6.1, 6.2; 7.1, 7.2 and the respective opposing fixed contacts 8.1, 8.2; 9.1, 9.2.

During the switching operation, a moment is transmitted to the contact bridges 4, 5 by the plunger 3 which generates the friction force in the contact points 10.1, 10.2; 11.1, 11.2.

In the manufacture of the microswitch 1, a small misalignment in the arrangement of the fixed contacts and the movable contacts can occur. It is thus for example possible that the pairs of fixed contacts 8.1, 8.2; 9.1, 9.2 are slightly vertically misaligned. To even out this misalignment, the contact bridges 4, 5 are each mounted rotatably about an axis which

extends transversely with respect to the longitudinal direction of the plunger and transversely with respect to the longitudinal extension of the contact bridges 4, 5, whereby a rocking motion of the contact bridges 4, 5 is permitted. However, it is also possible that the fixed contacts 8.1, 8.2; 9.1, 9.2 are misaligned in a horizontal plane. This misalignment is evened out by mounting the contact bridges 4, 5 rotatably about the longitudinal direction of the plunger. To facilitate these rocking or rotary motions, respectively, of the contact bridges 4, 5, the upper bearings 17, 18 of the plunger 3 are provided with a rounded support surface.

It can furthermore be possible that the distance of the pairs of fixed contacts 8.1, 8.2 from the pairs of fixed contacts 9.1, 9.2 does not correspond to the distance of the contact bridges 4, 5 from each other. This can be evened out by the springs 27, 28.

As can be taken from the figures, the movable contacts 6.1, 6.2; 7.1, 7.2 have a semicircular cross-section. The fixed contacts 8.1, 8.2; 9.1, 9.2 are preferably designed with a V-shaped cross-section. By this shape of the movable contacts and the fixed contacts, frictional movement is facilitated.

Claims

1. Microswitch (1) with at least two contact points (10.1, 10.2; 11.1, 11.2) with one movable contact (6.1, 6.2, 7.1, 7.2) and one fixed contact (8.1, 8.2, 9.1, 9.2) each, wherein the movable contacts (6.1, 6.2, 7.1, 7.2) are arranged on a contact bridge (4, 5), the contact bridge (4, 5) is movable by means of a plunger (3) and can be transferred from a first switching position in which the contact points (10.1, 10.2, 11.1, 11.2) are open to a second switching position in which the contact points (10.1, 10.2, 11.1, 11.2) are closed, **characterized in that** the contact bridge (4, 5) is mounted such that the contact bridge (4, 5) performs a rotary motion about an axis of rotation extending in parallel to its longitudinal extension during closing and opening of the contacts (6.1, 8.1; 6.2, 8.2; 7.1, 9.1; 7.2, 9.2), whereby a forced frictional movement transversely with respect to the longitudinal extension of the contact bridge (4, 5) is performed between the opposing contacts (6.1, 8.1; 6.2, 8.2; 7.1, 9.1; 7.2, 9.2) of each contact point (10.1, 10.2, 11.1, 11.2).
2. Microswitch (1) according to claim 1, **characterized in that** the plunger (3) comprises at least one upper bearing (17, 18) against which the contact bridge (4, 5) lies in the closed position, and at least one lower bearing (15, 16) against which the contact bridge (4, 5) lies in the open position, wherein the upper bearing (17, 18) is arranged diagonally with respect to the lower bearing (15, 16).
3. Microswitch (1) according to one of claims 1 or 2, **characterized in that** the contact bridge (4, 5) comprises at least one first lever (19, 20) arranged transversely with respect to the longitudinal extension of the contact bridge (4, 5) which is mounted in a seat (21, 22) in the plunger (3).
4. Microswitch (1) according to claim 3, **characterized in that** the first lever (19, 20) is arranged centrically between the two movable contacts (6.1, 6.2; 7.1, 7.2) at the contact bridge (4, 5).

5. Microswitch (1) according to one of claims 3 or 4, **characterized in that** the contact bridge (4, 5) comprises a further lever (23, 24) which is arranged opposite to the first lever (19, 20) and is guided in a guide (25, 26) in the plunger (3).
6. Microswitch (1) according to one of claims 1 to 5, **characterized in that** the contact bridge (4, 5) is mounted rotatably about an axis extending transversely with respect to the longitudinal axis of the plunger and transversely with respect to the longitudinal extension of the contact bridge (4, 5).
7. Microswitch (1) according to one of claims 1 to 6, **characterized in that** the contact bridge (4, 5) is mounted rotatably about the longitudinal axis of the plunger.
8. Microswitch (1) according to one of claims 1 to 7, **characterized in that** the upper bearing (17, 18) of the plunger (3) comprises a rounded support surface.
9. Microswitch (1) according to one of claims 1 to 8, **characterized in that** the microswitch (1) comprises at least one further contact bridge (5; 4) which is designed and mounted essentially identically to the first contact bridge (4; 5).
10. Microswitch (1) according to claim 9, **characterized in that** each of the contact bridges (4, 5) is supported at the plunger (3) by means of a spring (27, 28) in the longitudinal direction of the plunger (3), wherein one end of the spring (27, 28) is connected to the contact bridge (4, 5) and the other end of the spring (27, 28) is arranged in a seat (31, 32) in the plunger (3).
11. Microswitch (1) according to one of claims 9 or 10, **characterized in that** a centering projection (29, 30) for the spring (27, 28) is arranged on each of the contact bridges (4, 5).
12. Microswitch (1) according to one of claims 1 to 11, **characterized in that** the fixed contacts (8.1, 8.2, 9.1, 9.2) have an essentially V-shaped cross-section and the movable contacts (6.1, 6.2, 7.1, 7.2) have an essentially semicircular cross-section.

13. Microswitch (1) according to one of claims 1 to 12, **characterized in that** the microswitch (1) comprises a housing (2) and the plunger (3) is guided in the housing (2), wherein the housing (2) comprises a centering part (13) which guides a centering element (14) of the plunger (3).