Feb. 3, 1970 R. RAMSTETTER 3,493,702

QUICK ACTION SWITCH WITH SHARP EDGE CONTACTS

Filed June 17, 1968

FIG. 1

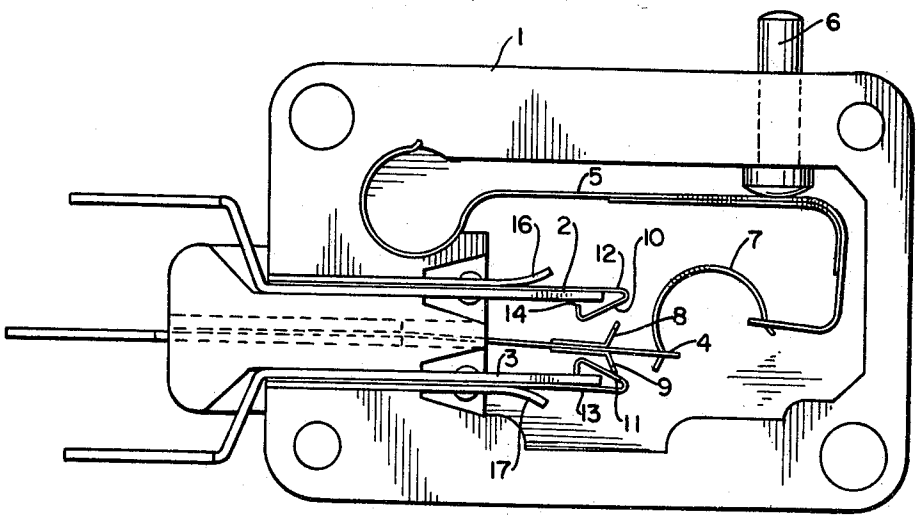


FIG. 2

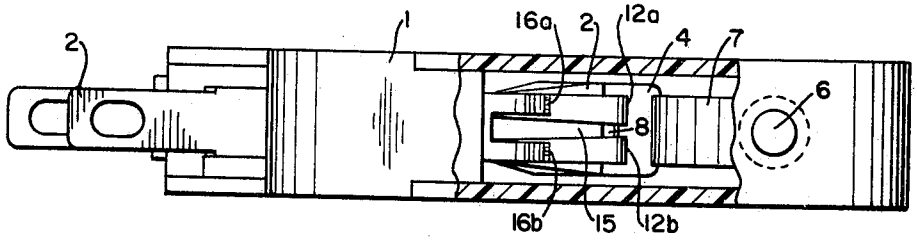


FIG. 3a

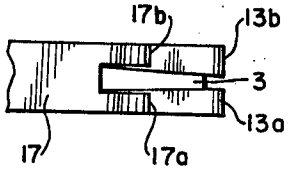


FIG. 3b

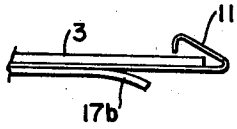


FIG. 4

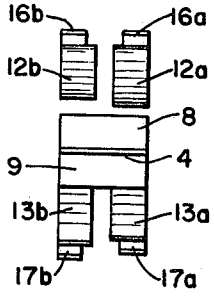
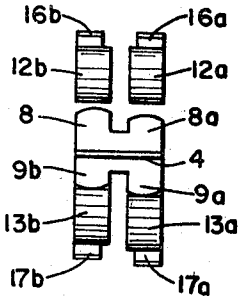


FIG. 5



INVENTORS
RUDOLF RAMSTETTER

BY Wolfe and Wolfe

ATTORNEYS

United States Patent Office

3,493,702
Patented Feb. 3, 1970

3,493,702

QUICK ACTION SWITCH WITH SHARP EDGE CONTACTS

Rudolf Ramstetter, Starnberg, Germany, assignor to Polycontact AG, Chur, Switzerland

Filed June 17, 1968, Ser. No. 737,546
Claims priority, application Germany, Feb. 14, 1968, P 44,017; Austria, June 19, 1967, A 5,667/67
Int. Cl. H01h 13/28
U.S. Cl. 200—67 19 Claims

ABSTRACT OF THE DISCLOSURE

A swingable switching contact is arranged for the movement between two countercontacts. The tip portion of the switching contact is provided with two oppositely arranged tongues terminated with a sharp contacting edge. Each of the countercontacts on the other hand is provided with a sloping contacting surface resiliently declined against the tongue to form an acute angle therewith. The countercontacts are preferably divided into a number of subcontacts having different shape to avoid vibration effects.

The present invention relates to a snap-switch for switching of low voltages or currents, which has a resiliently arranged switching contact actuated by a snap or a quick-action member and which cooperates preferably with two countercontacts disposed in the plane of movement of the switching contact and being flexibly displaceable about a definite lift.

In snap-switches, i.e. in switches where the switching-over from one position of the movable switching contact into the other one occurs abruptly upon attaining of a certain point on the path of motion of the snap member, the quality of the resulting connection depends besides to other factors also upon changes of the contacting material always occurring after a time period due to the burning off. Moreover, the contact quality depends on that how quickly the movable switching contact portion which when being switched over impinges against the counter-contact, is brought into the rest position insuring the desired stabilized contacting state.

In order to reduce the burning off or the vibration effects, various methods have been known from prior art suggesting how to avoid the above mentioned disadvantageous effects.

For example, it has already been proposed in the German Patent No. 1,127,435 to arrange the limit stops for a bistable leaf spring arm in such a way as to support the latter between the point of engagement with a pressing member and a switching contact lying in the proximity of this point of engagement. Such an arrangement results in that the point of the movement of the quick-action mechanisms at which the momentary switching process is released is completely independent on the condition of contacts, temperature and the like. Nevertheless, this known device can avoid vibrations of contacts in a very unsufficient manner only, since the leaf spring arm which is adapted for being switched over and supports switching contacts abuts not only against a resiliently arranged counter-contact, but also against a fixed counter-contact. According to impact laws, this fixed counter-contact behaves as if it has an infinitely large mass. Consequently, the pulse from the impinging switching contact becomes necessarily reversed so that it must jump back. The spring like counter-contact will continue, nevertheless, due to the previously imparted pulse, in the old

direction, so that for short time intervals contact disconnections occur. As a result, this switch is also not free from thumping. In the German Patent No. 1,166,322 there has been described a rigid ring-shaped buffer provided for a spring-like counter contact, and embossed through a concentrically arranged contacting member of this spring-like counter-contact. This measure has an advantage residing in that the adjustment of the main contact can be substantially avoided, that no burning-off on the main contact results and that after corresponding trimming of the resilient force of the moveable switching contact to the spring will abut substantially without vibrations against a further contact which at the same time works as a buffer. However, even this known device is able to eliminate the vibrations in a limited degree only, as mentioned in the description of the patent, since a portion of the counter-contact is again carried out as a fixed buffer and all of the above-mentioned shortcomings must occur even in this embodiment.

From the Austrian Patent No. 178,827 it has been known how to produce an arrangement of contacts which has reduced vibration effects. In this arrangement, a movable auxiliary mass lies upon a movable contacting piece. By means of such known structure the elimination of vibrations can be attained for the primary impact, eventually also for the secondary impact only, but in no event for the impacts of higher order. Moreover, the production cost thereof is high and the dimensioning of individual parts is so considerable that the final device can be applied only for units having big dimensions.

Accordingly, the primary object of the present invention is to create a snap-switch for switching of very low voltages and currents.

Another object of this invention is to create a snap-switch having minimum construction cost and, in particular, having minimum dimensions of respective construction parts.

Further object of this invention is to provide a snap-switch where the vibration effects are completely eliminated. The latter feature has a particular importance in the so-called microswitches employed in electronic systems where, as known, any vibration in the switch results due to the subsequently connected amplifying stages in considerable disturbance at the output.

A still further object of this invention is to produce a snap-switch wherein the moveable switching contact abuts the counter-contact not only without vibrations, but also which makes it possible to produce a perfect connection of metal contacts applicable for accurate switching of lowest electrical currents and voltages.

According to the present invention the above objects are attained so that in the snap-switch of the aforementioned kind of the moveable switching contact is provided with contacting tongues respectively cooperating with one of the counter-contacts and directed thereto, each contacting tongue having a sharp abutting edge, whereby corresponding counter-contact has a resilient contacting surface which is declined against the moveable switching contact and sloping down in the direction of movement of the switching tongue. These resilient sloping contact surfaces are adapted for being stopped by the inner surface of the supporting leaf springs. The entire configuration of the contacts is in accordance with the present invention adjusted so that upon abutment of the contacting tongue against corresponding sloping surface, the latter forms with the former an acute angle.

Due to the above-described arrangement, the snap-switch of this invention operates completely without vi-

brations, since the masses moving during the switching process are extraordinarily reduced in weight and more particularly, since the tongues of the moveable switching contact abut the sloping surfaces in the direction of inclination thereof and resiliently accept the kinetic energy of the moveable switching contact. Since the resilient contacting surface is inclined about a sharp angle to the direction of movement of the respective switching tongue, a sliding motion results between the abutting edge of the switching tongue and the contacting surface whereby due to the friction a damping effect is attained. Owing to the motion of the counteracting contacts and owing to the sharp edge of the contacting tongue, there results a perfect connection as a consequence because of mechanical cleaning up of the contacting surfaces and because of the relatively high specific contact pressures.

In a modification of the present invention, it is useful to limit by means of rigid limit stops the lift of the resilient contacting surfaces abutting the moveable switching contact, by which limitation it becomes possible to define accurately the points of contact. In the snapswitch according to the present invention the moveable switching contact can be carried out in conventional manner in the form of a unilaterally biased leaf spring which on the free end thereof cooperates via a resilient quick action or snap-member with an actuating lever. Also, the contacting surfaces of the counter contacts can be carried out as unilaterally biased leaf springs whereby the respective leaf springs are preferably arranged in parallel one to another. In order to produce a frictional movement between the contacting surfaces of counter-contacts on the one hand and the moveable switching tongues on the other hand, the radius of the annular motion of the moveable switching contact can be superior to that of the contacting surfaces of each of the counter contacts.

The contacting surfaces of the counter-contacts can be declined in such a manner that the portion thereof which faces the site of clamping of the moveable switching contact **4** has a minimum distance from the latter. The convenient magnitude of the angle between the contacting surface and the direction of movement of the moveable switching tongue is derived from the lengths of radii of movement of respective leaf springs as well as from impinging switching forces. The switching forces themselves are dependent to a great extent on the dimensions of the springs employed. For switches which should meet the requirements of a long in time and undisturbed operation it is necessary to make the moveable switching tongues as well as the contacting surfaces of the counter-contacts of a corrosion free and well conductive metal alloy such as for example of gold alloy.

A particularly effective variation of the heretofore described snap-switch of the present invention is based on a measure known from the relay technology, according to which the active contact portions are divided into subcontacts. In accordance with the present invention and by contrary to the measures as known from prior art, all sub-contacts are created to be flexible in the plane of the movement of the switching tongue and to have different spring, mass- or damping-constants.

By this arrangement it is attained that the mechanical pulse resulting from the action of the moveable switching contact causes the initially unactuated subcontacts of the counter-contact to exercise different motions. When the above-mentioned constants are properly adjusted, it can be accomplished, for example, that upon impact of the moveable switching contact one of the subcontacts is moved first with an equal or smaller speed than that of the moveable switching contact and, consequently, it remains as long upon the moveable switching contact as the other subcontact which has been moved faster, comes back. Simultaneously, it keeps braking the moveable switching tongue and the initially slower subcontact is allowed now to be removed.

Another advantageous modification of this invention resides in the fact that the subcontacts can be staggered one to another in the plane of the movement of the moveable switching contact. Also, the contacting tongue can be designed in such a way that the connection takes place at different points of time. Therefore, the subcontacts move not only with different frequencies or amplitudes, but also with different phases and a favorable condition for the contact operation is attained.

The different mass-, spring- and damping-constants of the subcontacts can be carried out in different ways. For example, the parts of the subcontacts which are determinative for resulting vibration frequency can be produced of materials having different specific weights. From the technological point of view it is very effective to divide the free end of the counter-contact by a longitudinal cut in such a manner that two unsymmetrically shaped subcontacts result. For example, the longitudinal slit can be produced diagonally to the longitudinal lateral edges or in parallel to the latter, but off the center line.

Another possibility for an advantageous adjustment of constants consists in that the vibrating portions of the subcontacts by means of an adequate location of the site of clamping are made differently long. Also, the cross sections of the subcontacts can be differently large. Finally, the subcontracts can be subjected to various preliminary treatments, such as for instance, cold treatment or the hot one. Further, the subcontacts can be clamped between materials having different elasticity, or guided so that each of them will move under different frictions.

Finally, the subcontacts can have different properties on the surface portions coming into contact with the contacting tongue. Thereby it will be achieved not only the above described cleaning effect of the upper surface, but it can be achieved also a different condition for sliding motion of the contacts. When the counter-contact, as mentioned above, is splitted by a longitudinal slit, then the former measure from the technological point of view is particularly advantageous. The slit can be carried out by punching so that for each subcontact there is a possibility of mounting contacting rivets thereupon. The production of countercontacts having different cross-sections can be technologically accomplished for example so that the subcontacts thereof are produced of a profiled tape.

Naturally, different cross-sections can be produced also through cutting. The different elasticity of the subcontacts can be accomplished besides the above-mentioned steps also by the application of differently alloyed metals.

The invention will become more readily apparent from the following description of a specific embodiment thereof shown, by way of example, and illustrated in the accompanying drawing, in which:

FIG. 1 is a side elevation of an open micro-switch of the present invention;

FIG. 2 is a top view of the micro-switch of FIG. 1 shown partially in a broken-out cross-section;

FIG. 3*a* is a detailed bottom view of a counter-contact;

FIG. 3*b* is a side view of a detail of FIG. 3*a*;

FIG. 4 is a schematic top view from the front of staggered subcontacts; and

FIG. 5 is a schematic top view from the front of another variation of contact arrangement for abutting the subcontacts at different points of time.

Referring now to FIG. 1, there is shown therein a movable switching contact **4** arranged for swingable movement between countercontacts **12** and **13** which are respectively supported on leaf springs **2** and **3**. The swingable switching contact **4** in the shown embodiment is formed of an elongated resilient blade which at one end thereof is firmly clamped in the housing **1** to form an electrical terminal and, at the opposite end thereof, is coupled to an actuating lever **5** by means of a quick-action resilient member having a semi-circular configuration. A push-button **6** is slidably arranged in the wall of the switch housing **1** to control the unilaterally biased

actuating lever 5. When the push-button 6 is depressed, the actuating lever 5 is lowered from its rest position and, consequently, the resilient quick-action member 7 abruptly reverses the stable positions of the moveable switching contact 4.

In accordance with this invention, the swingable switching contact 4 is provided on its moving free end with two tongues 8 and 9 respectively terminated with a sharp contacting edge. The counter-contacts 12 and 13, on the other hand, are declined to form sloping contact surfaces 10 and 11 facing against respective tongues 8 and 9. The tip portion of each of the countercontacts is further bent towards the supporting leaf spring 2 or 3 and adapted for a resilient lift about a travel distance 14. The tongues are directed towards corresponding sloping contact surfaces to form an acute angle therewith in the direction of the sliding motion of the tongues. The leaf springs 2 and 3 are led-out through the wall of the housing to form electrical terminals and clamped thereto by means of clamping inserts 16 and 17. The elongated portion of counter-contacts 12 and 13 is sandwiched between the corresponding leaf spring and clamping insert. Each of the clamping inserts 16 and 17 within the switch housing is at a certain distance from the site of the attachment to the housing riveted to the adjacent leaf spring and bent upwardly to adjust the radius and thereby the lift of the countercontacts. The counter-contacts can be reinforced in the region of their deflection either by dimensioning of material or by means of reinforcing sickles (not shown) in order to operate as unilaterally biased springs.

Since the tongue engages the sloping surface with a sharp contacting edge, there results an increased specific contact pressure. At the same time, the engaged sloping surface is flexibly depressed and is moved over the distance 14 until the deflected tip thereof is stopped against the inner surface of the leaf spring.

As it is apparent from FIGS. 2, 3*a* and 3*b*, a further characteristic feature of the present invention resides in that the counter-contacts 12 and 13 can be longitudinally splitted to form a number of parallel subcontacts 12*a* and 12*b*, respectively, 13*a* and 13*b* as shown in FIGS. 3, 4 and 5. The subcontacts are separated one from the other by a longitudinal split 15 which is excentrically arranged to provide different shapes of the subcontacts. As a consequence of different dimensioning of subcontacts 12*a* and 12*b*, respectively 13*a* and 13*b*, the latter vibrate at different frequencies upon impingement of the moveable switching contact 4 so that the abutting tongue is always in contact with one of the aforementioned subcontacts. Therefore, the counter-contact is always electrically connected with the tongue and mechanically firmly attached to the supporting leaf spring, preferably integral therewith at the site of attachment, so that a dependable and undisturbed connection results between the moveable switching contact and countercontact. The clamping member 16 is also provided along its longitudinal axis with a longitudinal cut-out corresponding with the slot 15 and the resulting divided lateral end portions 16*a* and 16*b* thereof are bent upwardly, respectively downwardly, as seen in the clamping member 17*b* of FIG. 3*b*. It is evident in detail in FIGS. 3*a* and 3*b* that in the rest position the sloping surface 11 is divided into two subcontacts 13*a* and 13*b* having different shape and being clamped between the leaf spring 3 and respective clamping end portions 17*a* and 17*b*.

As seen in FIG. 4, the sloping surfaces of the subcontacts 12*a* and 12*b* respectively of 13*a* and 13*b* may have also different dimensions in height as to be stepped with respect to the contacting tongue. Due to this arrangement, the contacting tongues 8 and 9 make the momentary connection at different points of time.

FIG. 5 shows another variation for producing connection at different points of time. In this embodiment, the subcontacts 12*a* and 12*b*, respectively 13*a* and 13*b* are disposed in the rest position on equal levels. By contrary, each of the contacting tongues is profiled to form a staggered configuration 8*a* and 8*b*, respectively 9*a* and 9*b*. By this arrangement it is attained that the vibration effects are still more diminished.

What is claimed is:

1. A snap-switch for switching-over low voltages and currents comprising a movable switching contact member actuated by a quick-action member to reverse abruptly its normal position, said switching contact being disposed preferably between two counter-contact members arranged in a spaced relationship one to another in the plane of movement of said switching contact member, said switching contact supporting contacting tongues respectively directed to corresponding counter-contacts and terminated with sharp contact edges, said counter-contacts being provided with resilient sloping surfaces facing said contacting tongues and inclined in such a direction as to abut the latter at an acute angle.

2. The snap-switch according to claim 1 wherein said movable switching contact member is a first leaf spring unilaterally clamped in the housing of said switch to swing about a first radius, said countercontacts comprising leaf spring means unilaterally attached to said housing to extend substantially in parallel with said first leaf spring whereby said countercontacts having shorter radius of movement than said first radius.

3. The snap-switch according to claim 2 wherein said resilient sloping surfaces in the rest position thereof are arranged as close as possible to said movable switching contact.

4. The snap-switch according to claim 3 wherein said contacting tongues and said sloping surfaces are made of gold alloy.

5. The snap-switch according to claim 1 wherein said counter-contacts are divided into a number of separate subcontacts adapted for a different vibrating motion.

6. The snap-switch according to claim 5 wherein each of said subcontacts has a different constant of elasticity.

7. The snap-switch according to claim 5 wherein each of said subcontacts has different mass.

8. The snap-switch according to claim 5 wherein said subcontacts have different damping properties.

9. The snap-switch according to claim 5 wherein said subcontacts on each of said counter-contacts are stepped in height with respect to the counteracting tongue to provide connection at different points of time.

10. The snap-switch according to claim 5 wherein the contacting edge of each tongue is staggered with respect to the cooperating subcontacts to insure vibrations of different phase.

11. The snap-switch according to claim 5 wherein the frequency determining parts of the subcontacts are made of material having different specific weights.

12. The snap-switch according to claim 5 wherein each of said counter-contacts is provided with an elongated unsymmetrical slot dividing the former into two unsymmetrical subcontacts.

13. The snap-switch according to claim 12 wherein said elongated slot is cut out diagonally to lateral edges of said counter-contact.

14. The snap-switch according to claim 12 wherein said elongated slot is cut out in parallel with and off the longitudinal axis of said counter-contact.

15. The snap-switch according to claim 5 wherein said subcontacts are respectively clamped to the supporting leaf spring by a separate clamping portion.

16. The snap-switch according to claim 5 wherein said subcontacts are made of material having different preliminary treatment.

17. The snap-switch according to claim 5 wherein said subcontacts are clamped between materials having different flexibility.

18. The snap-switch according to claim 5 wherein the sloping surfaces of respective subcontacts have different surface properties.

19. The snap-switch according to claim 5 wherein the resilient sloping surfaces are bent towards the inner surface of the supporting leaf spring to provide a limit stop for respective subcontacts.

References Cited

UNITED STATES PATENTS

2,897,308	7/1959	Fergus.
3,176,109	3/1965	Wodtke.
3,260,829	7/1966	Auer.
3,297,851	1/1967	Jaquet.

FOREIGN PATENTS

910,561	11/1962	Great Britain.
995,933	6/1965	Great Britain.

ROBERT K. SCHAEFER, Primary Examiner

D. SMITH, JR., Assistant Examiner

U.S. Cl. X.R.

200—166