2110473

(17)

"SLIDE SWITCH"

This invention relates to a slide switch which can be assembled in either one of a short-circuit type and a nonshort-circuit type by simply selecting a desired type of movable contact to be used in the switch.

In a typical construction of conventional slide switch of the above described type, a plurality of fixed contacts have been arranged on an insulating substrate so as to be aligned in a single plane, each of the fixed contacts providing a large width portion near the substrate and a small width portion remote from the substrate. A common terminal member has also been provided in the plane of the fixed contacts to extend in parallel with the substrate on the side of the fixed contacts remote from the substrate. A movable contact is also provided in a manner such that it always contacts the common terminal member at a portion thereof extending in parallel with the substrate. A kind of the movable contact of a short-circuiting use is, beside of the above described portion constantly contacting the common terminal member, further provided with a portion transferringly in contact with the large width portions of the fixed contacts, while another kind of the movable contact of a nonshort-circuiting use is, beside of the above described constantly contacting portion, further provided with a portion transferringly in contact with the small width portions of the fixed contacts.

Since the differentiation between the short-circuiting type and the nonshort-circuiting type of the conventional slide switch has been achieved by the positional difference of the portion of the movable contact contacting with either one of the large width portion and the small width portion of the fixed contact as described above, the height measured from the

substrate of a contact line formed by the transferringly contacting portion of the short-circuit type movable contact is inevitably made different from the height from the substrate of another contact line formed by the transferring contact portion of the nonshort-circuit type movable contact, thus entailing a drawback of the conventional slide switch of requiring a comparatively large height from the insulating substrate and increasing the entire size of the slide switch.

A primary object of the present invention is to provide a slide switch whose height and size are reduced.

Another object of the invention is to provide a slide switch wherein the movable contact of either type can be constructed symmetrically and therefore the sliding movement thereof is extremely smooth.

Still another object of the invention is to provide a slide switch wherein a "fall in" phenomenon of the transfer contact can be substantially prevented.

A further object of the invention is to provide a slide switch wherein the contacting forces in either types of the movable contact can be substantially equalised.

These and other objects of the present invention can be achieved by a slide switch of the present invention which comprises an insulating substrate; a plurality of fixed contact members arranged on said substrate so as to be aligned in a plane perpendicular to said substrate; a common terminal member provided substantially in said plane of said fixed contact members to extend along the arrangement of said fixed contact members on the side remote from said substrate; a movable contact member made of a resilient, electrically conductive sheet-like member bent into two halves and slidably mounted on said common terminal

member so that the bent portion of said sheet-like member rides on an edge of said common terminal member remote from said substrate, each of said two halves including two arm portions extending from said bent portion integrally therewith towards said substrate, a connecting portion connecting both ends of said two arm portions to each other to form a substantial U-shape, a first contact portion extending from said connecting portion integrally therewith towards said substrate and having a contact formed thereon as one of a first contact pair for slidably nipping therebetween said fixed contact members and a second contact portion extending from said connecting portion integrally therewith towards said bent portion and having a contact formed thereon as one of a second contact pair for slidably nipping therebetween said common terminal member; and a plurality of spacers provided in the plane of said fixed contact members along the passage of said first contact pair and interposed alternately between adjacent ones of said fixed contact members, for preventing said first contact pair from falling inwardly.

The invention will be described in detail with reference to the accompanying drawings which are briefly described as follows.

In the accompanying drawings:

Figure 1 is a front view showing an important part of a conventional slide switch of a nonshort-circuit type;

Figure 2A is a cross-sectional view of the conventional slide switch sectioned along the E-E line in Figure 1;

Figure 2B is a cross-sectional view of the slide

switch modified into a short-circuit type as shown in Figure 3 sectioned along the line C-C' in Figure 3;

Figure 3 is a front view showing an important part of the conventional slide switch shown in Figure 1 modified into a short-circuit type;

Figure 4 is a front view showing an important part of a slide switch according to the present invention

constructed as a nonshort-circuit type;

FIG. 5 is a profile view of a movable contact used in the slide switch shown in FIG. 4;

FIG. 6 is a plan view of the movable contact used in the slide switch shown in FIG. 4;

FIG. 7 is a front view showing an important part of the slide switch of this invention modified into a short-circuit type;

FIG. 8 is a front view showing another example of the movable contact constructed into a nonshort-circuit type;

FIG. 9 is a diagram used for explaining the operation of the slide switch shown in FIG. 4;

FIG. 10 is a diagram used for explaining the operation of the slide switch shown in FIG. 7;

FIG. 11 is a diagram used for explaining the operation of another example of the slide switch of the short-circuit type;

FIG. 12 is a sectional view showing an example of a slide switch according to the present invention;

FIG. 13 is a cross-sectional view taken along the line D-D in FIG. 12; and

FIG. 14 is a plan view showing the bottom of a body used in the example shown in FIG. 12.

Before entering the description of the present invention, a conventional construction of the slide switch will be described with reference to FIGS. 1 to 3.

In the construction, a plurality of fixed contacts 12-1 to 12-4 are arranged in a linear manner along an insulating substrate 11. The fixed contacts 12-1 to 12-4 have wide portions 13-1 to 13-4 adjacent to the substrate

11, where the widths of the portions are widened in the arranged direction of the fixed contacts 12-1 to 12-4, and narrow portions 14-1 to 14-4 remote from the substrate 11 where the widths of the portions are reduced. Beside of the above described portions, the fixed contacts 12-1 to 12-4 have portions extending downwardly through the substrate 11 and formed into terminals 1-1 to 1-4 of the fixed contacts 12-1 to 12-4, respectively.

A common terminal member 15 is provided in the plane including the fixed contacts 12-1 to 12-4 to surround these contacts. The member 15 is secured to the insulating substrate 11 at both ends thereof with respect to the arranged direction of the fixed contacts. One of the two ends of the member 15 extends downwardly through the substrate 11 to be formed into a terminal 16 of the common terminal member 15. The common terminal member 15 has projections 2-1 to 2-3 formed integrally therewith and extending downwardly between the adjacent pair of the narrow portions 14-1 to 14-4 of the fixed contacts 12-1 to 12-4.

A movable contact 20 is mounted on the common terminal member 15 in a manner to stride the same member. The contact member 20 is made of a resilient and electrically conductive material, and formed to provide contact pairs 21-1, 21-2 and 22-1, 22-2 which are spaced apart in the direction of the arrangement of the fixed contacts as shown in FIGS. 1 and 2A. The contact pair 21-1 and 21-2 resiliently hold a part of the common terminal member 15 extending in parallel with the substrate 11, while the contact pair 22-1 and 22-2 resiliently hold therebetween either one of the projections 2-1 to 2-3 and the corresponding one of the narrow portions 14-1 to 14-4, both located in a contact line A-A' shown in FIG. 1.

The movable contact member 20 shown in FIGS. 1

and 2A is of a nonshort-circuit type, and when the contact member 20 is moved in a sliding manner in the arranged direction of the fixed contacts (hereinafter termed a sliding direction) so that the contact pair 22-1 and 22-2 are displaced from one of the narrow portions 14-1 to 14-4 to the other, there always exists a period where the contact pair are brought into contact with only one of the projections 2-1 to 2-3 projected from the common terminal member 15, and therefore is carried out a transferring operation or switching operation of so-called nonshort-circuit type where the contact pair are brought into contact with one of the fixed contacts only after the contact pair have been completely separated from the adjacent one of the fixed contacts.

FIGS. 2B and 3 illustrate a modification of the conventional slide switch shown in FIG. 1 so that it is operable as a short-circuit type slide switch. This modification is different from the slide switch shown in FIGS. 1 and 2A only in the point that the contact pair 22-1 and 22-2 are resiliently brought into contact with the wide portions 13-1 to 13-4 of the fixed contacts while the contact pair are displaced along a line B-B' in FIG. 3.

When the movable contact member 20 shown in FIG. 3 is moved in the sliding direction, since the wide portions 13-1 to 13-4 are closely adjacent with each other, the contact pair 22-1 and 22-2 of the contact member 20 are brought into contact with one of the wide portions 13-1 to 13-4 while it is still in contact with the adjacent one of the wide portions, thus maintaining the two portions of the fixed contacts in a short-circuit state during the transferring operation between the two adjacent fixed contacts.

In the above described construction of the

(25)

conventional slide switch, since the operational mode of the slide switch is differentiated by differentiating the heights of the portions of the fixed contacts brought into contact with the contact pair 22-1 and 22-2 of the movable contact member 20 measured from the substrate 11 as shown by the lines A-A' and B-B' in FIGS. 1 and 3, the height of the fixed contacts and therefore the size of the entire slide switch have been increased inevitably. In addition, in order to achieve, in long term, smooth and stable sliding contact between the movable contact member 20 and the common terminal member 15, it is necessary to provide a suitable resilient force to the contact pair 21-1, 21-2, thus necessitating a suitably long length L between the top of the movable contact member 20 and the contact pair 21-1, 21-2. Accordingly, the width D of the common terminal member 15, which is longer than L, should become relatively large, increasing the height of the common terminal member 15. Furthermore, since the heights of the two contact pairs measured from the substrate 11 are also different between each other, the movable contact member 20 is made asymmetric with respect to the vertically disposed center line of the contact member 20, and the contacting forces of the two contact pairs are made different by the forward movement and the rearward movement of the contact member 20. Such a difference in contacting forces tends to cause undesirable positional deviation of the movable contact member 20 regardless of the type thereof during its sliding operation thus making it difficult to obtain accurate operation of the slide switch.

According to the present invention, all of the above described difficulties of the conventional slide switch can be substantially eliminated, and there is provided an improved slide switch wherein the height of

the entire switch measured from the substrate 11 can be substantially reduced, the resilient holding state of the movable contact member 20 which holds the common terminal member 15 and the fixed contacts 12-1 to 12-4 is made stable, and the sliding operation of the slide switch is extremely smooth.

FIG. 4 illustrates an important part of a preferred embodiment of the present invention constructed into a nonshort-circuit type. In this embodiment, spacers 25-1, 25-2, ... are formed by the projections projected integrally from the common terminal member 15 extended in the arranged direction of the fixed contacts 12-1 to 12-4. Each of the spacers 25-1, 25-2, ... is interposed between adjacent two of the narrow portions 14-1, 14-2, ... of the fixed contacts to such an extent that the tip of the spacer substantially reaches the boundary region between the narrow portion and the wide portion of the fixed contacts. The thickness of the spacers 25-1, 25-2, ... is selected to be substantially equal to that of the narrow portions 14-1, 14-2, ... of the fixed contacts 12-1, 12-2, ...

As shown in FIGS. 4 through 6, the movable contact member 20 is so constructed that it strides to cover the front and rear side surfaces of the common terminal member 15. For the realization of smooth sliding operation of the movable contact member 20, guide portions 20-A and 20-B may be provided integrally at both ends of a planar portion 20a of the contact member 20 riding on an extended part 15a of the common terminal member 15 extending in parallel with the substrate 11 such that the guide portions 20-A and 20-B are tapered outwardly upwardly away from the upper edge of the extended part 15a.

Planar portions 20b and 20c of the movable contact member 20, facing the front and rear side surfaces of the

(27)

common terminal member 15, respectively, are cut off in an inverted U-shaped pattern at the central parts thereof adjacent to the upper planar portion 20a, and the parts left within the inverted U-shaped pattern are bent inward thereby to provide the contact pair 21-1 and 21-2. The planar portions 20b and 20c of the movable contact member 20 are at their central portions further extended toward the substrate 11 and bent inward toward each other thereby to provide the other contact pair 22-1 and 22-2. As a consequence the contact pair 21-1 and 21-2 resiliently hold the common terminal member 15 from both sides thereof at a substantially central position of the movable contact member 20 with respect to the sliding direction thereof. Likewise the contact pair 22-1 and 22-2 resiliently hold the narrow portion 14-1, 14-2, or else of the fixed contact 12-1, 12-2, or else from the two sides of the narrow portion at another substantially central position of the movable contact member 20 with respect to the sliding direction thereof.

The length W_1 measured in the sliding direction of the movable contact member 20 of the contact pair 22-1 and 22-2 contacting with the fixed contact is selected to be larger than the distance G_1 between the spacer 25-1, 25-2, or else and the narrow portion 14-1, 14-2, or else adjacent to the spacer, and smaller than the width W_2 of the narrow portions 14-1, 14-2, ... Thus in the case where the movable contact member 20 is of the nonshort-circuit type and the contact pair 22-1 and 22-2 are transferred from, for instance, the narrow portion 14-1 to the narrow portion 14-2, there always exists a state where the contact pair 22-1 and 22-2 resiliently hold only the spacer 25-1 as shown in FIG. 9, thereby executing a nonshort-circuit transfer operation. Furthermore, since

$W_1 > G_1$ is assumed the contact pair 22-1 and 22-2 contact with the spacer 25-1 before the contact pair depart from the narrow portion 14-1 and then contact with the narrow portion 14-2 before the contact pair depart from the spacer 25-1. As a result, any possibility of causing so-called "fall-in" phenomenon wherein the contact pair fall inward between the adjacent narrow portions 14-1 and 14-2 can be eliminated, and a smooth sliding movement of the movable contact member 20 is thereby assured. For further promoting the smooth sliding movement of the movable contact member 20, the contact surfaces of the contact pair 22-1 and 22-2 may be tapered at both ends thereof with respect to the sliding direction such that the contact surfaces separate from each other toward the sliding directions.

The movable contact member 20 is symmetric relative to a center line of the member 20 extending vertically to the sliding direction, and, in the case of Fig. 4, the contact pairs 21-1 and 21-2 and 22-1 and 22-2 are all placed on the center line. Moreover, the movable contact member 20 is arranged such that a sliding force will be applied substantially a midpoint between the contact pairs 21-1 and 22-1 (also 21-2 and 22-2). Accordingly the positioning of the movable contact member 20 relative to the common terminal member 15 and the fixed contacts 12-1, 12-2, ... is extremely stable, and therefore the sliding movement of the movable contact member 20 is extremely smooth. Furthermore, the contact pair 22-1 and 22-2 of the movable contact member 20 are formed on the first parts of the planar portions 20b and 20c extending downwardly from an edge portion near the substrate 11 and bent inwardly toward each other, while the contact pair 21-1 and 21-2 of the member 20 are formed on the second parts of the planar portions 20b and 20c extending upward from the edge

portion to be bent inwardly toward each other. Since the distance along the way from each of the contact portions 21-1, 21-2, 22-1, 22-2 via the midportion between the contact portions 21-1 and 22-1 (or between the contact portions 21-2 and 22-2) to the bent portions defining the boundary between the planar portion 20b (or 20c) and the planar portion 20a can be selected to be comparatively long and equal to each other, the contact pairs can be brought into contact with the common terminal member 15 and the fixed contacts 12-1, 12-2, ... under sufficient resiliency of equal strengths.

FIGS. 7 and 10 illustrate an embodiment made operable in the short-circuit mode. In the shown construction, the planar portions 20b and 20c of the movable contact member 20 are also formed in a similar manner. More specifically, however, two contact portions 22-11 and 22-12 (22-21 and 22-22) extend integrally from the planar portion 20b (20c) in a direction opposite to that of the contact portion 21-1 (21-2) extending upwardly. The contact portions 22-11 and 22-12 (22-21 and 22-22) are arranged in the sliding direction of the movable contact member 20 symmetrically relative to the vertical center line of the planar portion 20b (20c), and bent inward toward the mating contact portions 22-21 and 22-22 (22-11 and 22-12) formed on the planar portion 20c (20b), so that the fixed contacts are resiliently held between the two contact pairs 22-11, 22-21 and 22-12, 22-22 thus formed. In this construction, the distance D_1 between the outer ends of the contact pairs is selected to be larger than the distance D_2 between the inner ends of the adjacent two fixed contacts measured at the narrow portions thereof, and smaller than the distance D_3 between the inner edges of the adjacent two spacers.

During the sliding movement of the movable contact

member 20 of the above described construction, when the contact pairs 22-11, 22-21 and 22-12, 22-22 are shifted from the narrow portion 14-1 of the fixed contact 12-1 to the narrow portion 14-2 of the fixed contact 12-2 as shown in FIG. 10 with a spacer 25-1 interposed between the two narrow portions, there is always an instant when the contact pair 22-11 and 22-21 contact the narrow portion 14-1 while the contact pair 22-12 and 22-22 contact the narrow portion 14-2, and therefore the movable contact member 20 short circuits the two fixed contacts 12-1 and 12-2. In other words, a short-circuit type transfer operation is carried out between the fixed contacts.

FIG. 11 shows a modification of the above described short-circuit type construction of the movable contact member 20. In this modification, the two contact portions 22-11 and 22-12 shown in FIGS. 7 and 10 are combined into a single contact portion 22-1, while the two contact portions 22-21 and 22-22 are combined into another single contact portion 22-2.

The invention may otherwise be modified such that a slit 3 extending in the sliding direction of the movable contact member 20 is provided between the contact portion 21-1 (21-2) and the contact portion 22-1 (22-2) as shown in FIG. 8. Although the modification has been described with respect to the nonshort-circuit type construction, it is apparent that the slit 3 may otherwise be provided in the short circuit type movable contact member 20 in the same manner as described above.

As can be seen from the foregoing explanations of the embodiments with reference to FIGS. 4 and 7, since the contacts between the fixed contacts and the movable contact is made always on a line lying on the narrow portions 14-1, 14-2, ..., the height of the wide portions

13-1, 13-2, ... can be reduced as low as possible or can be omitted, by that the entire height of the slide switch can be reduced. However, in the embodiments shown in FIGS. 4 and 7, the wide portions 13-1, 13-2, ..., which can be very short in height in comparison with those shown in FIGS. 1 and 2, are provided for securely fixing the fixed contacts to the substrate 11 against the friction force applied by the contact portions 22-1, 22-2, or 22-11, 22-21, 22-12, 22-22 in the direction of sliding. Also, it will be understood from FIGS. 4 and 7 that the position of the contact pair 21-1, 21-2 can be raised up to near the upper edge of the extended part 15a of the common terminal member 15, by that the width D of the common terminal member can be reduced, allowing reduction of height of the slide switch.

The above described slide switch may be combined into a single unit as shown in FIGS. 12 and 13. In the shown example, an insulating body 31 of a rectangular configuration is provided slidably on the substrate 11. A single or a plurality of grooves 32 are extended through the insulating body 31 along its length. Since two rows of fixed contacts 2-1 to 2-4 (which are not provided with wide portions in this example) and corresponding common terminal members 15 are used in the shown example, two grooves 32 are extended as described above. The grooves 32 are expanded in the widthwise direction at portions 33-1 and 33-2 for encasing the movable contacts 20-1 and 20-2. A frame 34 made of a metal plate bent formed into an inverted U-shape is provided to cover the insulating body 31 entirely, so that the downwardly disposed opening of the frame 34 is closed by the substrate 11. The lower edges of the frame 34 are bent inward at several parts thereof thereby to hold the substrate 11 between the two edges.

An elongated opening 35 is provided through the upper part of the frame 34 opposing to the substrate 11. A knob 36 formed integral with the insulating body 31 extends upward through the opening 35. By moving the knob 36 in the sliding direction of the movable contacts, the movable contact members 20-1 and 20-2 are both moved simultaneously in their sliding direction thereby to carry out the transferring operation of the slide switch unit.

As described hereinbefore, the slide switch according to the present invention can be converted between the nonshort-circuit type and the short-circuit type by simply changing the shape of the movable contact member, or more specifically by changing the width in the sliding direction of the contact portions 22-1 and 22-2 contacting with the fixed contacts 12-1, 12-2, ... successively, while maintaining the constructions of the fixed contacts 12-1, 12-2, ... and the common terminal member 15 unchanged, and therefore the number of parts required for the production of the two types of the slide switch can be substantially reduced and the production cost of the same can be substantially economized.

Furthermore, the contact position of the contact portions 22-1 and 22-2 moving along the fixed contacts 12-1, 12-2, ... is substantially held constant regardless of the different types of the slide switch, so that the height of the fixed contacts and else measured from the substrate 11 can be substantially reduced thereby reducing the size of the entire slide switch. More specifically, the height of the wide portions 13-1, 13-2, ... of the fixed contacts 12-1, 12-2, ... provided as shown in FIGS. 4 and 7 can be substantially reduced, or if it is desired, can be reduced to zero.

The movable contact member 20 is made symmetric

(33)

with respect to its center line, and therefore the contact member 20 can be held stably and resiliently relative to the common terminal member 15 and the fixed contacts 12-1, 12-2, ... during the sliding operation of the contact member 20. In addition, because of the provision of the spacers 25-1, 25-2, ..., "fall-in" phenomenon of the contact portions 22-1 and 22-2 of the movable contact member 20 between adjacent narrow portions 14-1, 14-2, ... can be prevented, and a smooth transfer movement of the contact member 20 is thereby assured. The invention further provides advantageous feature of equalizing the contacting forces between the contact pairs 21-1, 22-2 and 22-1, 22-2 exerted to the common terminal member 15 and the fixed contacts 12-1, 12-2, ...

Although the invention has been described with respect to the embodiments wherein the spacers 25-1, 25-2, ... are formed integrally with the common terminal member 15, the spacers may otherwise be made of, for instance, an insulating material and combined respectively with the common terminal member 15.

* C L M S *

(34)

CLAIMS:

1. A slide switch comprising an insulating substrate; a plurality of fixed contact members arranged on said substrate so as to be aligned in a plane perpendicular to said substrate; a common terminal member provided substantially in said plane of said fixed contact members to extend along the arrangement of said fixed contact members on the side remote from said substrate; a movable contact member made of a resilient, electrically conductive sheet-like member bent into two halves and slidably mounted on said common terminal member so that the bent portion of said sheet-like member rides on an edge of said common terminal member remote from said substrate, each of said two halves including two arm portions extending from said bent portion integrally therewith towards said substrate, a connecting portion connecting both ends of said two arm portions to each other to form a substantial U-shape, a first contact portion extending from said connecting portion integrally therewith towards said substrate and having a contact formed thereon as one of a first contact pair for slidably nipping therebetween said fixed contact members and a second contact portion extending from said connecting portion integrally therewith towards said bent portion and having a contact formed thereon as one of a second contact pair for slidably nipping therebetween said common terminal member; and a plurality of spacers provided in the plane of said fixed contact members along the passage of said first contact pair and interposed alternately between adjacent ones of said fixed contact members, for preventing said first contact pair from falling inwardly.

* C L M S *

2. A slide switch as set forth in Claim 1 wherein the width of said first contact pair is selected to be equal to or larger than the distance between adjacent ones of said fixed contact members and said spacers.

3. A slide switch as set forth in Claim 2 wherein said width of said first contact pair is selected to be smaller than the width of said fixed contact members along the passage of said first contact pair.

4. A slide switch as set forth in Claim 2 wherein said width of said first contact pair is selected to be smaller than the distance between adjacent ones of said spacers and larger than the distance between adjacent ones of said fixed contact members along the passage of said first contact pair.

5. A slide switch as set forth in Claim 1 wherein the shape of each of said two halves of said movable contact member is made symmetric relative to a centre line perpendicular to said bent portion of said movable contact member.

6. A slide switch as set forth in Claim 1 wherein each of said first contact portions is divided into a plurality of portions by one or more slits formed therein in a direction perpendicular to said substrate and a contact is formed on each of said divided portions to provide a plurality of said first contact pairs.

7. A slide switch as set forth in Claim 1 wherein a slot is formed in said connecting portion of each of said two halves to extend in a direction parallel to the slide movement of said movable contact member.

8. A slide switch as set forth in Claim 1 wherein said spacers are formed integrally with said common terminal member to extend therefrom towards said substrate.

9. A slide switch substantially as hereinbefore described with reference to Figures 4 to 6, Figure 7, Figure 8 or Figures 12-14 of the accompanying drawings.