

CERTIFIED TRANSLATION**A SWITCH-OPERATING LEVER UNIT FOR SWITCHES**

The invention relates to a switch-operating lever unit for switches in accordance with the preamble of claim 1. The invention in particular relates to a switch-operating lever unit adapted to be mounted into a low-voltage switch.

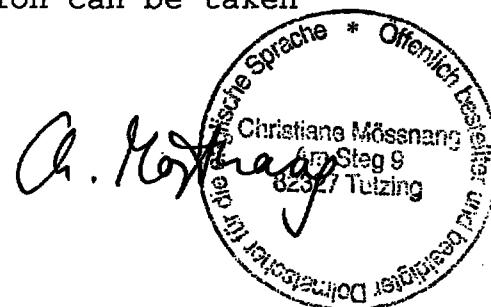
From the publication EP 0 560 697 B1 a generic switch-operating lever unit is known in which a diametrically extending recess passes through the circular-cylindrical switch-operating lever body. Apart from an S-shaped contact lever also a tensioning device acting upon the former and being equipped with springs is comprised in said recess. The switch-operating lever unit of such design is rotatably supported in the housing of a power switch by means of the cylindrical circumferential area of the switch-operating lever body.

From the further publication EP 0 314 540 B1 a switch-operating lever unit having a similar design is known whose substantial difference from the switch-operating lever unit according to EP 0 560 697 B1 consists in the specific design of the tensioning device.

It is the object of the invention to provide a switch-operating lever unit which has a longer life and is less susceptible to discharges occurring in the switching space which are caused by short-circuit.

This object is achieved by the combination of the features defined in the independent claims.

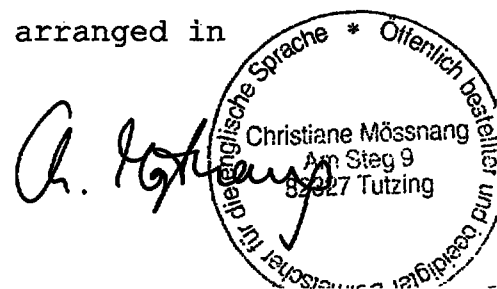
Advantageous further developments of the invention can be taken from the subclaims.



A possibility of achieving the aforementioned object according to the invention consists in providing a switch-operating lever unit in which caps for covering and laterally mounting the switch-operating lever body are arranged at two opposite sides of the switch-operating lever body. In such a design the bearing friction caused by the function of the switch-operating lever unit is restricted to particular sections which are relatively difficult to be attacked by discharges caused by short circuit in the contact space due to their special position at the switch-operating lever body.

When designing the switch-operating lever unit a tensioning device arranged substantially at the opposite sides of the switch-operating lever body and covered by the caps can act on the contact lever. Thus the tensioning device is housed in an area protected by the caps outside the recess of the switch-operating lever body which receives the contact lever and is exposed to the impact of discharges caused by short circuit. With such an arrangement the movable parts of the tensioning devices remain substantially protected so that the function of the switch-operating lever unit is hardly impaired by operational influences.

In accordance with a further development of the switch-operating lever unit, the caps are positively connected to the opposite sides of the switch-operating lever body by means of two sections which are formed diametrically opposed with respect to each other. This design ensures a quick and safe mounting of the caps. Such sections can be, for instance, projections which are formed at the inside of the caps and are adapted to be engaged with grooves provided at the opposite sides of the switch-operating lever body. It is useful in this context to form one of the grooves as a through hole provided in the switch-operating lever body which at the same time can be used for receiving a pin to operate the switch-operating lever unit. In this way plural switch-operating lever units arranged in



parallel to each other can be operated by a single rod-like pin passing through the switch-operating lever body.

In the switch-operating lever unit according to the invention the tensioning device substantially consisting of two springs is preferably housed in two duct-like grooves which extend diametrically and in parallel to each other at the sides of the switch-operating lever body. These grooves at the same time form engaging portions for projections appropriately provided at the inside of the caps. The alignment of the grooves preferably has to be chosen such that the direction of extension of each groove encloses an angle ranging from 20° to 70° with the line which connects the diametrically opposed engaging portions formed at the switch-operating lever body.

In another alternative embodiment of the switch-operating lever unit the sections provided for producing a positive connection between the switch-operating lever body and the cap comprise projections which are formed at the opposite sides of the switch-operating lever body and are adapted to engage with recesses incorporated in the disc-shaped caps. These recesses are preferably designed as U-shaped cutouts in the disc-shaped caps, wherein rib-shaped projections which are adapted to engage with corresponding slit-like grooves of the switch-operating lever body extend from the bottom sections of the U-shaped cutouts.

In the case of this alternative design of the switch-operating lever unit each cap preferably has two crossing grooves at its inside facing the respective side of the switch-operating lever body so that, irrespective of the mounting side of the cap, either of these grooves is always aligned overlapping the duct-shaped groove at the switch-operating lever body.

In all embodiments of the switch-operating lever unit each cap preferably includes at its outside a bearing journal for supporting the switch-operating lever body, the bearing journal

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having a substantially smaller diameter than the diameter of the switch-operating lever body which has a cylindrical design per se. Thereby the risk of impairing the bearing position of the switch-operating lever unit by discharges caused by short circuit in the contact space of the switch are largely eliminated and simultaneously the friction at the bearing position is minimized.

An alternative combined solution of the object according to the invention can also be achieved by a switch-operating lever unit in which the tensioning device is arranged outside of the space receiving the contact lever inside the switch-operating lever body or is covered at the switch-operating lever body. The covered arrangement of the tensioning device can in turn be achieved in a particular case by detachable caps at the switch-operating lever body.

Hereinafter the invention will be explained in detail by way of two embodiments with reference to the drawings, where

Fig. 1: shows a partial sectional view of a housing of an arc extinguishing device of a low-voltage switch in which the switch-operating lever unit according to the invention is mounted;

Fig. 2: shows the switch-operating lever unit represented in Fig. 1 in the turned-off state of the switch;

Fig. 3a: is a perspective partially exploded view of a first embodiment of the switch-operating lever unit according to the invention;

Fig. 3b: is a representation of the switch-operating lever unit in Fig. 3a in a partly assembled state;



Fig. 4a: shows a perspective partially exploded view of a second embodiment of the switch-operating lever unit according to the invention;

Fig. 4b: is a representation of the switch-operating lever unit in Fig. 4a in a partly assembled state.

A low-voltage switch not illustrated in detail in Fig. 1 includes an arc extinguishing means consisting of a housing 11, a switch-operating lever unit 9 accommodated in a housing, arc chambers, current-carrying conductors 16 and further members which improve the arc extinction. The housing 11 of the arc extinguishing means is mounted in a housing of the low-voltage switch not shown in detail. The switch-operating lever unit 9 serves for making an electric connection between the two current-carrying conductors 16.

The switch-operating lever unit 9 substantially consists of a cylindrical switch-operating lever body 2 on which an S-shaped contact lever 3 is rotatably supported by means of a bearing axis 5 mounted in this body. The entire switch-operating lever unit 9 is rotatably supported in a not represented receiving portion of the housing 11, wherein the special type of this support will be explained in detail within the scope of the following representation of the constructional design of the switch-operating lever unit.

The switch-operating lever unit 9 can be operated by means of a joint 10 to obtain the turned-on state shown in Fig. 1 or the turned-off state of the switch shown in Fig. 2.

As one can take in detail from Fig. 3a, the switch-operating lever unit 9 consists of a switch-operating lever body 2 which has a rotationally symmetrical, approximately cylindrical design. The axis of the cylindrical switch-operating lever body 2 is coincident with the geometrical axis of the bearing axis 5 at which the contact lever 3 is movably supported. The contact

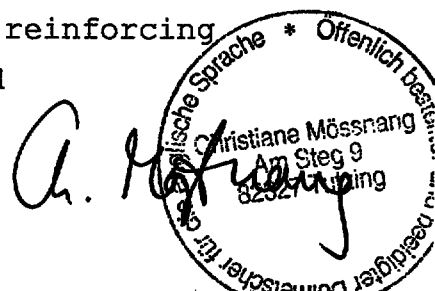
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lever 3 is received in a recess 2e extending perpendicularly to the axis of the switch-operating lever body 2, the recess passing diametrically through the switch-operating lever body 2.

Grooves 2c which extend diametrically and in parallel to each other and are duct-shaped are provided on both faces of the cylindrical switch-operating lever body 2. At the ends of the duct-shaped grooves 2c U-shaped slits 2d provided for receiving pins 6 are incorporated in the wall between the central recess 2e and the bottom portion of the respective groove 2c. A roller 6a which is slidably received in the recess 2e is rotatably supported approximately centrally on each pin 6. In the duct-shaped grooves 2c springs 7 are received which are hung up on both sides at the ends of the tensioning pins at each face of the switch-operating lever body 2. The length of the slits 2d is dimensioned, compared to the width of the central bearing portion of the S-shaped contact lever 3, such that, irrespective of the operating state of the switch, the pins 6 can by no means be contracted to the stop at the bottoms of the U-shaped slits 2d. A twisting of the switch-operating lever body 2 results in the fact that the rollers 6a of the pins 6 unroll on the respectively adjacent summits of the S-shaped contact lever 3 and, in so doing, are forced apart in the slits 2d opposite to the force of the spring 7 contracting the tensioning pins 6 so as to thereby exert a permanent anti-clockwise tensioning force upon the contact lever 3.

The switch-operating lever body 2 moreover has a receiving hole 2b in which a rod-like pin 1 is received. At both faces of the switch-operating lever body 2 U-shaped recesses 2a are incorporated diametrically opposed to the receiving hole 2b.

Caps 8 are provided at both sides of the cylindrical switch-operating lever body 2. Each cap 8 includes a circumferential cylindrical collar portion 8e and is provided at its inside with a pair of approximately diametrically extending reinforcing ribs 8c as well as a U-shaped rib portion 8a formed



independently of the former. The reinforcing ribs also serve for increasing the creep distances and the air gaps in the arc extinguishing means of the switch.

Grooves 8i extending diametrally on the inside of the cap 8 are formed between the reinforcing ribs 8c of each cap 8. The caps can be positioned during their mounting at the switch-operating lever body 2 such that each of the grooves 8i is located level with the slits 2d of the switch-operating lever body 2 and receives the ends of the pins 6 by way of bearing. The grooves 8i which are effective in such an arrangement as axial restriction for the pins 6 thus serve as guides for the pins 6 during their operational displacement in the slits 2d so that the pins can be effectively prevented from possibly jamming in the slits 2d.

When arranging the respective cap 8 at the corresponding face of the switch-operating lever body 2 the sections 8c and 8a are brought into a positive connection with the duct-like groove 2c and the U-shaped recess 2a formed at the edge of the switch-operating lever body 2.

Moreover the cap 8 has an opening which is formed by a cylindrical portion 8b extending at the inside of the cap. The cylindrical portion 8b is diametrally opposed to the projecting U-shaped rib portion 8a and has an outer diameter approximately corresponding to the inner diameter of the receiving hole 2b formed in the switch-operating lever body 2. The line connecting the center of the cylindrical portion 8b to the center of the U-shaped rib portion 8a includes, with the diametral line hypothetically drawn between the ribs 8c, the same angle as the angle between the line connecting the recess 2a with the receiving hole 2b and the center line of the duct-like groove 2c. This angle principally ranges from 20° to 70° , preferably it is approx. 65° .



At the outside of one of the caps 8 a pin-shaped journal 8d is provided at the side diametrically opposed to the opening of the cylindrical portion 8b, i.e. behind the U-shaped rib portion 8a. The journal 8d serves as a mounting protection so that the switch-operating lever body 2 can be correctly mounted into the housing 11 of the switch not shown in detail.

Each cap 8 is provided at its outside with a bearing journal 8f which serves for axially supporting the switch-operating lever unit 9 in the not represented receiving portion of the switch housing 11. At the external front face of each cap two diametrically opposed openings 8g are formed which serve for the pressure relief of the switch-operating lever body 2. One of the caps 8 includes at its collar portion 8e a projecting section 8h which simultaneously serves for marking the correct mounting position of the cap and the circumferential cover of the slits 2d as well as the rollers 6a in the switch-operating lever body 2.

When mounting the switch-operating lever unit 9 first the contact lever 3 is fitted into the recess 2e of the switch-operating lever body 2 such that the pin 5 serving as a joint axle can be pushed from outside through the switch-operating lever body 2 and a bearing hole of the contact lever 3 not represented in detail. Then the pins 6 are inserted in the slits 2d and the spring 7 is hung up on both sides of the switch-operating lever body at the ends of the pins by slightly extending the spring. Subsequently the two caps 8 are first compressed at both faces of the switch-operating lever body 2 until the U-shaped rib portion 8a provided at the insides of the caps, the ribs 8c and the cylindrical portion 8b are appropriately fitted into the U-shaped recess 2a, the duct-like groove 2c and the receiving hole 2b. The caps 8 are preferably manufactured of synthetic material so that the elevated portions 8a, 8c and 8b can be inserted on both sides of the switch-operating lever body 2 with a slight pressing power and

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therefore no additional means for fastening these caps to the switch-operating lever body are required.

The switch-operating lever unit 9 assembled in this way is then arranged in the housing 11 of the arc extinguishing means in a receiving portion not shown in detail in Fig. 1 such that the bearing journals 8f axially extending on both sides of the switch-operating lever unit can be received with sliding bearing portions of the receiving portion in corresponding contours. Then the joint 10 shown in Fig. 1 is arranged at an outside of the housing 11 so that the rod-like pin 1 can be inserted in an eye formed at the lower end of the joint 10 and an opening of one of the cylindrical portions 8b of the caps 8 which is aligned with the eye.

The Figures 4a and 4b illustrate a further embodiment of the switch-operating lever unit 9 according to the invention. This embodiment of the switch-operating lever unit substantially differs from the first embodiment illustrated in the Figures 3a and 3b by the different design of the faces of the switch-operating lever body and the caps.

The switch-operating lever body 22 represented in the Figures 4a and 4b includes a recess 22e extending perpendicularly to the axis of the switch-operating lever body in which the contact lever 23 comprising the contact members 24 is received and is supported on a pin 25. In the same way as in the first embodiment the extended cylindrical portions 26a of the pins 26 are brought into contact with the summit areas of the S-shaped contact lever 23, as indicated in the representation of Fig. 1, in order to exert an elastic pressing power upon the contact lever in its closed position when the switch-operating lever body 22 is turned anti-clockwise. This mechanism was explained already in connection with the first embodiment.

Two approximately rectangular projections 22a, 22b are formed diametrically opposed to each other at each face of the switch-

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operating lever body 22. The projections 22b formed at both faces of the switch-operating lever body 22 form the runouts of a bore portion provided in the switch-operating lever body 22 for receiving a rod-like pin 21, while in the projections 22a which are formed diametrically opposed thereto merely openings 22g are formed. There is provided a diametrically extending duct-like groove 22c between the projections 22a and 22b for receiving the spring 27. In the faces of the switch-operating lever body 22 slit-like grooves 22f are formed along the opposed sides of the projections 22a, 22b.

On both sides of the switch-operating lever body 22 plate-shaped caps 28 made of flat material are provided. These caps have a substantially flat disc shape including diametrically opposed cutouts 28a, 28b which are suited when placing the caps to receive the projections 22a, 22b formed at the faces of the switch-operating lever body 22. In their bottom area the U-shaped cutouts 28a, 28b include portions 28c bent toward the mounting side of the caps 28 which correspond in length to the width of the cutouts 28a, 28b, are adapted to be inserted into the slit-like grooves 22f for fastening the caps to the faces of the switch-operating lever body 22 and at the same time serve for increasing the creep distances and the air gaps in the switch.

In each inner surface of the caps 28, each of which is facing one of the fronts of the switch-operating lever body 22, moreover an X-shaped groove 28e is formed which is adapted, independently of the front at which the cap is to be arranged, to receive a portion of the spring 27 outwardly projecting from the front of the switch-operating lever body. This design of the groove 28e permits an exchangeability of the caps 28 to be arranged on both sides of the switch-operating lever body 22. As one can take from the representation in Figure 4b, the diameter of the plate-shaped caps 28 corresponds to the diameter of the cylindrical switch-operating lever body 22 so that, in the mounted state, the edges of the caps 28 are

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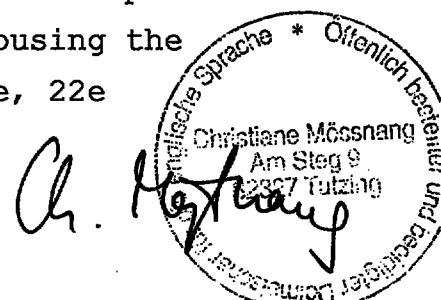
aligned flush with the cylindrical circumferential area of the switch-operating lever body 22.

At the outside of each of the caps 28 a bearing journal 28f is provided by means of which the switch-operating lever unit can be rotatably supported in an appropriately designed bearing portion of the housing 11 not shown in detail in Fig. 1.

The design of the switch-operating lever unit illustrated in detail in the foregoing at the same time ensures a support of the switch-operating lever unit having a simple construction in the switch housing and a reliable protection of the movable parts in the switch-operating lever body against electric discharges in the case of flashovers. Moreover the creep distances and air gaps from the contact lever 3, the springs 7 and the pins 6 to the rod-like pin 1, which in the case of a single-pole switch connects a drive not represented in detail with the switch-operating lever unit and in the case of multipolar switches both connects this drive with the switch-operating lever units and interconnects the switch-operating lever units, are increased. The caps are designed such that they ensure a reliable connection with the switch-operating lever body. The access of the gases occurring in the case of short circuits to the movable parts of the switch and the switch-operating lever unit is thereby impeded and an increased shielding against an adjacent switch unit is ensured.

A faulty mounting of the caps is impossible, because the latter either can be clearly distinguished from outside and therefore can be assigned to a particular side of the switch-operating lever body or have an identical shape but in that case can be arranged at any front of the switch-operating lever body.

In the case of an embodiment of the switch unit according to the invention not represented in detail the detachable caps can be dispensed with to simplify the manufacture by housing the tensioning device outside the area of the recess 2e, 22e



receiving the contact lever but still protected in the interior of the switch-operating lever body.

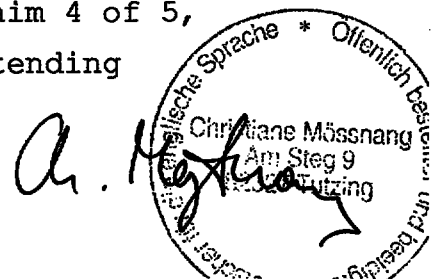
The foregoing is hereby certified to be a true and complete English translation of the photocopy of the document in the German language submitted to me, the said document being International application no. PCT/EP99/05570, which is identical to German priority application no. 19836754.6.
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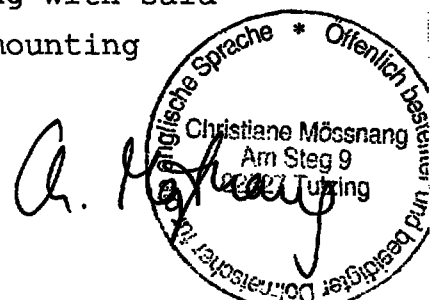
Claims

1. A switch-operating lever unit for switches comprising a switch-operating lever body (2; 22) and a contact lever (3; 23) mounted on said switch-operating lever body, characterized in that caps (8; 28) for covering and mounting said switch-operating lever body (2; 22) are arranged at two opposite ends of said switch-operating lever body (2; 22).
2. A switch-operating lever unit according to claim 1, characterized in that a tensioning device (7, 2d) arranged substantially at the opposite ends of said switch-operating lever body (2; 22) and covered by said caps (8; 28) acts on said contact lever (3; 23).
3. A switch-operating lever unit according to claim 1 or 2, characterized in that said caps (8; 28) are positively connected to the opposite ends of said switch-operating lever body (2; 22) by two portions formed diametrically opposed to each other (8a, 8b; 28a, 28b).
4. A switch-operating lever unit according to claim 3, characterized in that said portions represent projections (8a, 8b) formed at the inside of said caps (8) which are adapted to engage with grooves (2a, 2b) provided at the opposite ends of said switch-operating lever body (2).
5. A switch-operating lever unit according to claim 4, characterized in that one of said grooves is formed by a through hole (2b) provided in said switch-operating lever body (2) for receiving a pin (1) to operate said switch-operating lever unit.
6. A switch-operating lever unit according to claim 4 or 5, characterized by a duct-shaped groove (2c) extending



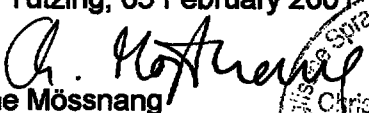
diametrically in said switch-operating lever body (2) for receiving said tensioning device (7, 2d) and two further projections (8c) provided at the inside of the respective cap (8).

7. A switch-operating lever unit according to claim 3, characterized in that the portions represent cutouts (28a, 28b) formed in said caps (8) which are adapted to engage with projections (22a, 22b) provided at the opposite ends of said switch-operating lever body (22).
8. A switch-operating lever unit according to claim 7, characterized in that the recesses constitute U-shaped cutouts in the disc-shaped caps (28), wherein bent portions (28c) which are adapted to engage with corresponding slit-like grooves (22f) of said switch-operating lever body (22) extend from the bottom portions of said U-shaped cutouts.
9. A switch-operating lever unit according to claim 7 or 8, characterized by a duct-shaped groove (22c) extending diametrically in said switch-operating lever body (22) for receiving said tensioning device (26, 27).
10. A switch-operating lever unit according to claim 6 or 9, characterized in that said groove (2c; 22c) in its direction of extension includes an angle ranging from 20° to 70° with the line interconnecting said grooves (2a, 2b) and/or projections (22a, 22b).
11. A switch-operating lever unit according to the claims 9 and 10, characterized in that each cap (28) has an X-shaped groove (28e) at its inside facing the respective end of said switch-operating lever body (22) so that said groove (28e) is always aligned to be overlapping with said duct-shaped groove (22c) independently of the mounting side of said cap (28).



12. A switch-operating lever unit according to anyone of the claims 1 to 11, characterized in that each cap (8; 28) comprises at its outside a bearing journal (8b; 28b) for mounting said switch-operating lever body (2; 22).
13. A switch-operating lever unit for switches comprising a switch-operating lever body (2; 22), a contact lever (3; 23) mounted in a recess (2e; 22e) of said switch-operating lever body and a tensioning device (6, 7; 26, 27) for acting on said contact lever, characterized in that said tensioning device (7, 2d) is arranged outside the space (2e; 22e) receiving said contact lever (3) and within said switch-operating lever body or is covered and mounted on said switch-operating lever body (2; 22).
14. A switch-operating lever unit according to claim 13, characterized in that said tensioning device (6, 7; 26, 27) is arranged to be covered at two opposite outsides of said switch-operating lever body (2) and said switch-operating lever body comprises bearing journals (8f; 28f).
15. A switch-operating lever unit according to claim 13 or 14, characterized in that said switch-operating lever body (2) is rotationally symmetrical and said tensioning device (6, 7; 26, 27) is covered by two caps (8; 28) which can be fastened to its outsides and support said bearing journals (8f; 28f).

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