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## (54) Snap switch for controlling motors of electrical apparatuses for motor vehicles

(57) Described herein is a snap switch for controlling motors of electrical apparatuses of motor vehicles, comprising an actuating button pivoted on a container body made up of a lid and a base, set within which are mobile contacts, pivoted on a fulcrum and made of a metal lamina, designed to close fixed contacts connected to a printed circuit; the metal lamina is moved by means of and acts upon an elastic pad made of silicone material provided with actuators and silicone bubbles set in positions corresponding to the ends of the metal lamina.

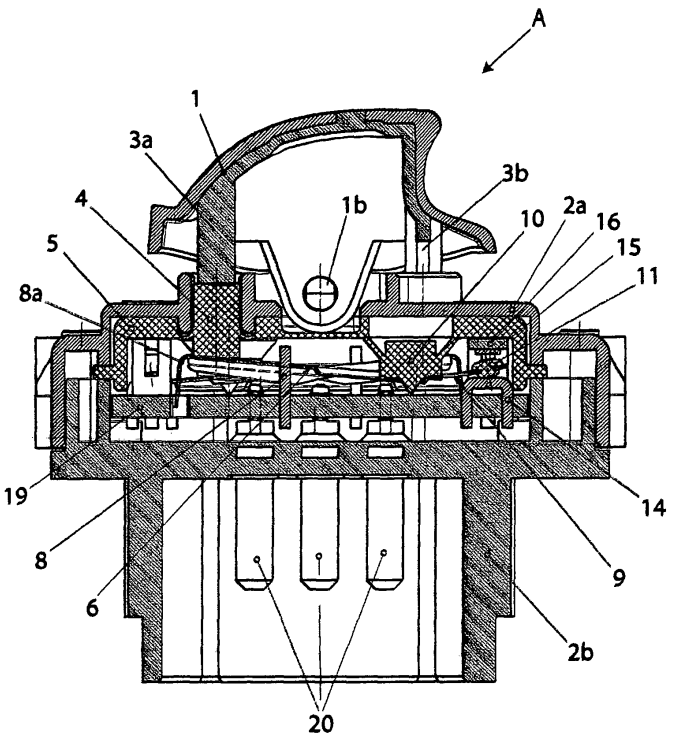


Fig. 1

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## Description

**[0001]** The present invention relates to a quick make-and-break switch or snap switch for controlling an electric motor for motor vehicles, suitable for driving directly the motor (power switch), always maintaining a feel of operation that is very similar to the one that is present on signal switches where snap action is obtained by means of silicone bubbles.

**[0002]** At the same time, a water-tight switch is provided by using the same element (silicone pad) that is used for generating said feel of operation.

**[0003]** Up to now the most widely used system for direct driving of electric motors, in particular for the power windows of motor vehicles, has been the one that uses snap-action laminas or else toggle systems in which the electrical contact is "switched" by a metal item pivoted at the centre that is made to toggle by a prod pressed by a spring in order to render the intermediate position as unstable as possible.

**[0004]** In fact, in order to be able to switch the loads that are required by the specific application, which are in the region of 12 A (rated) with peaks of 30 A, it is indispensable to render the instant of passage from "contact closed" to "contact open" as fast as possible and render it practically impossible for the user to stop in intermediate positions in the proximity of the point of closing of the contact.

**[0005]** In fact, in the above conditions, with the loads involved, there occurs flashing-over between the two contacts and a fast deposit of metal from the positive pole to the negative pole.

**[0006]** The above phenomenon degrades the electrical characteristics of the apparatus until functionality thereof is jeopardized when the "noble" material that forms the contact wears out, and the electrical contact continues to be made only on the metal that carries the contact.

**[0007]** As regards in particular switches for power windows, the above phenomenon can occur only on the normally open (NO) contact and not on the normally closed (NC) contact. In fact, it is only on the NO contact that by operating the switch the electrical load is interrupted, whereas on the NC contact only the passage of current occurs, and interruption is performed by another switch.

**[0008]** The purpose of the present invention is to exploit silicone bubbles for creating a snap switch for controlling motors of electrical apparatuses of motor vehicles, in particular for power windows, that will present characteristics of contact suitable for driving the motor directly, namely, an opening and closing of the contact that is very fast, aimed above all at preventing degradation of the NO contact.

**[0009]** The above purpose is achieved by the present invention, the subject of which is a snap switch for controlling motors of electrical apparatuses of motor vehicles that presents the characteristics of Claim 1.

**[0010]** Further characteristics and advantages will emerge clearly from the ensuing description, with reference to the attached plate of drawings, which is provided purely by way of non-limiting example and in which:

- Figure 1 is a cross-sectional view of the switch of the invention in the resting position, with the button in the neutral position;
- Figure 2 is a cross-sectional view of the switch of Figure 1 in an active position;
- Figure 3 is an exploded view of the switch of Figure 1;
- Figure 4 is an enlarged view of the silicone pad of the switch of Figure 1;
- Figure 5 is an enlarged view of a faston connector of the switch of Figure 1; and
- Figure 6 is an enlarged view of the metal lamina of the switch of Figure 1.

**[0011]** With reference to the figures, designated as a whole by A is a switch for controlling electric motors of motor vehicles, in particular for motors of power windows, made up of a button 1 pivoted in 1b on the body of the switch, formed by a lid 2a and a base 2b. The button is provided with two prods 3a and 3b, which act on cylindrical actuators 4 made integrally in a silicone pad 5 and connected thereto through a thin wall having a loop-like profile that enables a practically free relative movement thereof.

**[0012]** The silicone pad 5 is provided with silicone bubbles 10 of a known and widely used type and a peripheral edge 5a functioning as seal, which, when the body of the switch is closed, is pinched between the edges of the lid 2a and of the base 2b. In this way the part lying underneath the pad, with its contents, is rendered totally impermeable to atmospheric agents, thus guaranteeing proper operation of the switch.

**[0013]** Set underneath the pad 5 is a metal lamina 6 having an elongated shape, pivoted via a hole 6a on a fulcrum 8 fixed and electrically connected to a printed or sheared circuit 19, contained and fixed in the base 2b.

**[0014]** One end 8a of the metal lamina is set underneath the actuator 4, whereas the other end 9 of the lamina itself, provided with a flexible part 9a and an electrical contact 11 made of a material suited to the purpose, is located in a position corresponding to one of the silicone bubbles 10,

**[0015]** The metal lamina has a particular shape and mode of operation in so far as for the major part of its length it is substantially rigid, having two lateral turned-under edges that form a cross section substantially shaped like a U turned upside down, and this as regards the end 8 subject to the action of the actuator and the central part to which the fulcrum is connected. The second end 9 that comes to occupy a position underneath the silicone bubble continues to be rigid up to a point underneath the bubble and is provided with a central slit with bent-down stiffening edges 9b, which is designed to centre it on the bubble 10. The lamina terminates with the end part 9a formed by a flexible arched reed con-

nected to the end 9 and carrying said electrical contact 11.

**[0016]** A normally closed (NC) faston connector 14 and a normally open (NO) faston connector 16 are in turn electrically connected by force fit or soldering to said printed or sheared circuit 19, which in turn carries the electrical connection to faston connectors 20 contained in the base 2b, which have the purpose of providing a connection to the wiring through which the electric motor of the power window is directly driven.

**[0017]** The switch according to the invention functions in the way described in what follows.

**[0018]** The toggle button 1, by rotating about its two pins 1b slotted in the corresponding holes on the body of the switch formed by the lid 2a and the base 2b, produces a vertical displacement of the two prods (one upwards and the other downwards) made integrally on the button itself.

**[0019]** The prod that comes down in turn causes descent of the actuator 4, which in its travel downwards presses on the end of the metal lamina 6, pivoted on the fulcrum 8, depressing it and producing rotation of the metal lamina about said fulcrum.

**[0020]** In this rotation of the lamina 6, the other end 9 of the lamina itself, which is not pushed downwards by the actuator 4, moves upwards compressing the bubble 10 and drawing upwards also the flexible part 9a with the contact 11 fixed thereto.

**[0021]** The plot of the force versus the displacement of the present actuator is mainly defined by the characteristic curve of the silicone bubble, which, notoriously, has a first stretch of travel in which the force increases and a second stretch in which it decreases, with a profile that is very close to a sinusoid.

**[0022]** The above characteristic of feel of operation is the one proper to silicone-bubble switches for low currents that it is intended to maintain with this new application.

**[0023]** The flexible part 9a of the metal lamina 6 is studied in such a way as to have, in the resting conditions, a pre-load (elastic deformation due to the difference between the natural shape of the item and the profile that it is forced to assume after its assembly) such as to absorb the first part of the travel of the system (the one that for the characteristics of the bubble requires an increasing force) without detaching the contact 11 from the NC faston connector 14.

**[0024]** Upon entry into the step of actuation in which (once again on account of the characteristic of the silicone bubble 10) the system drastically decreases its reaction, the speed of the movement itself becomes much faster, and hence the contact 11 rapidly abandons the NC faston connector 14 and comes to rest on the contact 15 of the NO faston connector 16.

**[0025]** At this point, in which the force of reaction of the system is still decreasing and the contact 11 of the lamina 6 is already in contact with the NO faston connector 16, the flexible arms 18 of the lamina 6 once again start to undergo deformation but in the direction opposite to the previous one and absorb all the stretch of travel that remains up to arrest of the system due to the button 1 coming to bear upon the body of the switch.

**[0026]** Return into the resting position of the entire system takes place in the reverse order: after a first brief stretch in which the force decreases on account of the decompression of all the intermediate elements subjected to compression (actuator 4, metal lamina 6, central section of the silicone bubble) and during which the user may possibly manage to accompany the system slowly, the flexible part 9a of the lamina 6, which is in conditions of pre-loading on the NO faston connector 16, starts to distend again, without, however, abandoning the contact 15.

**[0027]** The system thus reaches the area of the characteristic curve of the silicone bubble in which there is a sharp rise in the force of reaction thereof, and the return travel undergoes a new acceleration.

**[0028]** At this point the flexible arms 18 of the lamina have completely exhausted the elastic deformation that kept them pressed against the NO faston connector 16 and rapidly detach the contact 11 from the faston connector itself and bring it back rapidly into contact with the NC faston connector 14 elastically re-absorbing the entire travel that remain up to the resting position of the system.

**[0029]** The entire system described, as is also clearly visible from the attached figures, is made up of two systems inside the switch, which work alternately, one during rotation of the button 1 in one direction, and the other during rotation of the button 1 in the opposite direction.

**[0030]** The above two systems, by opposing one another, enable also the button 1 to have a precise and stable position in the resting conditions.

**[0031]** From the point of view of the electrical circuit diagram, the various metal components create a switch, in which the fulcrum 8 and the lamina 6 perform the connection with the "common" contact to be switched, and the NC faston connector 14 and the NO faston connector 16 alternately become the outputs.

**[0032]** The fulcrum 8, the NC faston connector 14 and the NO faston connector 16 are in turn electrically connected via force fit or soldering to a sheared or' printed circuit 19, which in turn carries the electrical connection to the faston connectors 20 for connection with the wiring through which the electric motor of the power window is directly driven.

**[0033]** The same printed or sheared circuit 19, if so required, can carry electronic components (LEDs and resistors) necessary for enabling lighting-up of the switch or other electronic components that perform other desired functions.

**[0034]** The entire switch is then closed and sealed by the base 2b that carries all the components referred to above.

**[0035]** For the reasons set forth in the preamble of the description regarding the electrical aspects, it is to be

pointed out that it is much more important to calibrate the system in such a way as to guarantee the position of detachment of the contact 11 from the contact 15 of the NO faston connector 16 in the area of acceleration of the return speed rather than the position of detachment of the contact 11 of the NC faston connector 14 in the forward phase.

**[0036]** Once again for the same reason, a contact 7 is made on the NO faston connector 16 using a metal that is of higher quality from the electromechanical standpoint (higher conductivity and mechanical resistance to flashing-over and to higher temperatures), whereas on the NC faston connector 14 the passage of current occurs directly on the metal carrying the contact.

**[0037]** In order to increase the performance in terms of rapidity of opening and closing of the electrical contacts, there has been adopted on the actuation system consisting of the bubble 10 and the contact 11 a disadvantageous lever, whereby the lamina is actuated by the actuator with a shorter arm as, compared to the one at which the silicone bubble 10 is positioned so as to amplify the characteristics of force of the system and render steeper (and hence unstable) the area of the curve involved in closing of the contact.

**[0038]** A second solution useful for rendering the system more reactive and faster has been to make the actuator 4 of elastic material, which enables manual actuation of the system to be rendered less controllable, in so far as the central section in the forward phase is compressed and at the moment of snap-action of the bubble 10 restores part of the energy, impressing on the lamina 6 an additional acceleration, whereas in the return phase it absorbs part of the acceleration impressed by the bubble rendering slow return of the lamina 6 impossible in the case where the user were to attempt to obtain slow return thereof.

**[0039]** However, the adoption of the above elastic intermediate element (silicone pad) 5 is in no way binding and in no way limits the principle of operation of the system, and possibly an actuator made of practically rigid material could be used.

**[0040]** In addition, by adopting an elastic intermediate element (silicone pad) 5 made of transparent material, it will be possible to obtain lighting-up the outer surface of the button 1.

## Claims

1. A snap switch (1) for controlling motors of electrical apparatuses of motor vehicles, comprising an actuating button (1) pivoted on a container body made up of a lid and a base (2a, 2b), set within which are mobile contacts (11), pivoted on a fulcrum (8) and made of a metal lamina (6), designed to close fixed contacts connected to a printed circuit (19); said switch being **characterized in that** said metal lamina (6) is moved by means of and acts upon an elastic pad made of silicone material (5) provided with actuators (4) and silicone bubbles (10) set in positions corresponding to the ends (8, 9) of the metal lamina (6).

2. The snap switch according to Claim 1, **characterized in that** said lamina (6) has the end that is subjected to the action of the actuator (4) and the central part that is pivoted on the fulcrum (8) which are provided with lateral turned-under edges that form a cross section substantially shaped like a U turned upside down, and **in that** the second end (9) that comes to occupy a position underneath the silicone bubble (10) is provided with a central slit with bent-down stiffening edges (9b) designed to connect it to the bubble (10).

3. The snap switch according to Claims 1 and 2, **characterized in that** the lamina (6) terminates with the end part (9a) formed by an arched flexible reed connected to the end (9) and carrying said electrical contact (11) so as to compensate, without detaching the contact (11) from faston connectors (14, 16) for the step of loading before the switch snaps into the closed condition and for the step of return before the switch snaps into the open condition.

4. The snap switch according to Claim 1, **characterized in that** the silicone pad (5) is provided with a peripheral edge, which is designed to be pinched between the edges of said lid (2a) and said base (2b) of the body of the switch (A), thus closing in a sealed way the internal part of said body located underneath the pad.

5. The snap switch according to Claim 1, **characterized in that** the silicone pad (5) is made of transparent material.

6. The snap switch according to Claim 1, **characterized in that** the silicone pad (5) is provided with a peripheral edge, which is designed to be pinched between the edges of said lid (2a) and said base (2b) of the body of the switch (A), thus reducing propagation outwards of the noise due to closing/opening of the electrical contacts.

7. The snap switch according to Claim 1, **characterized in that** the lamina is made of a single piece.

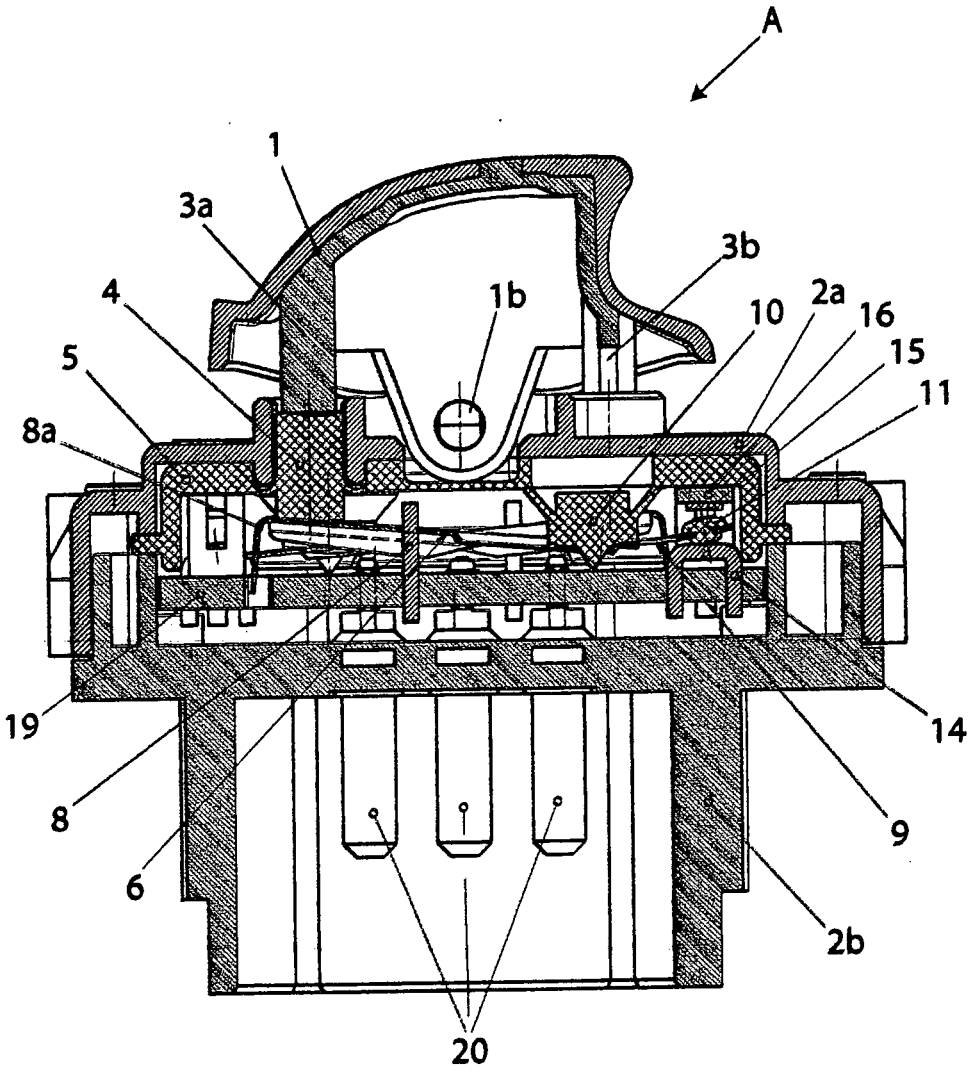


Fig. 1

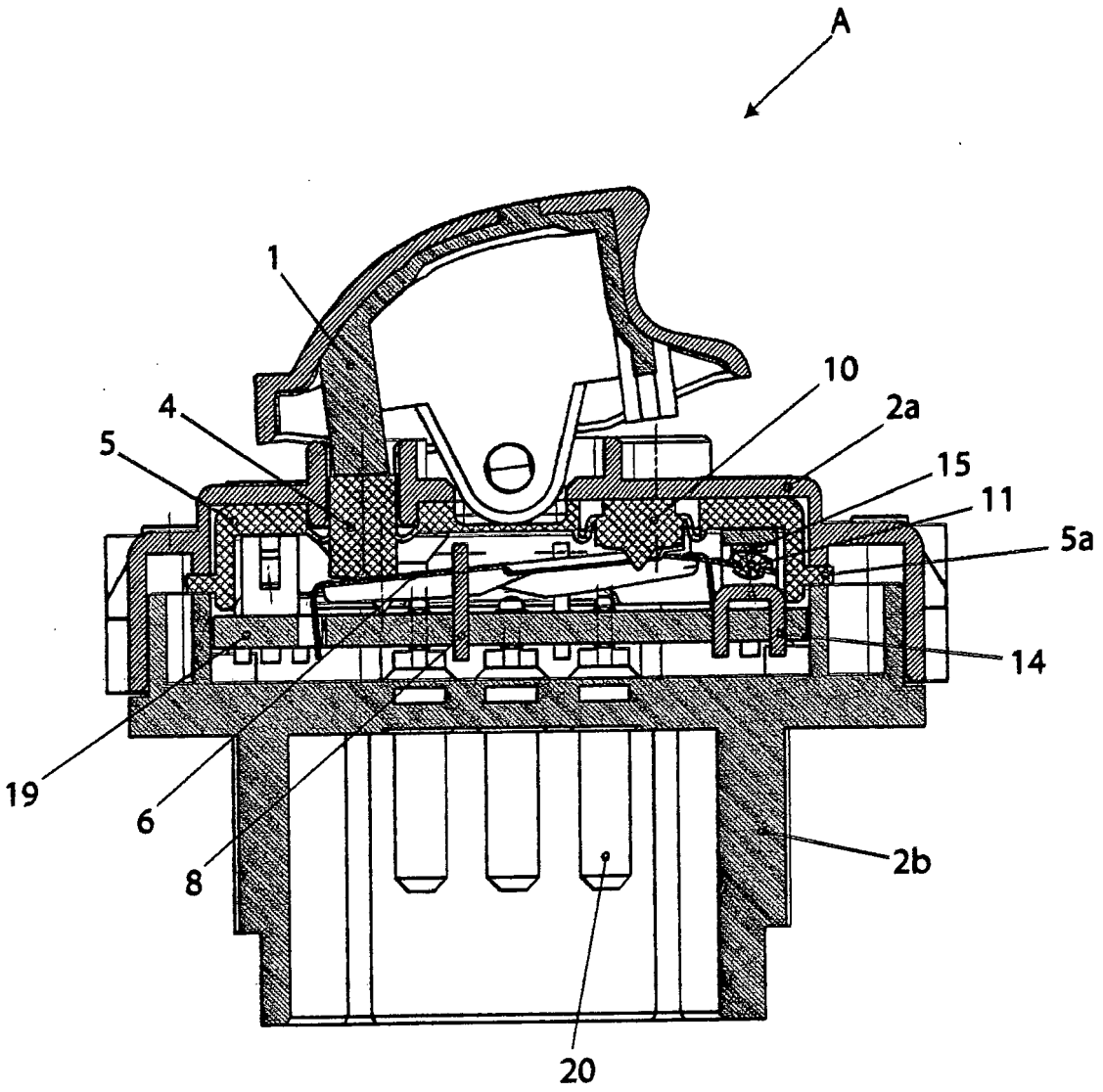


Fig. 2

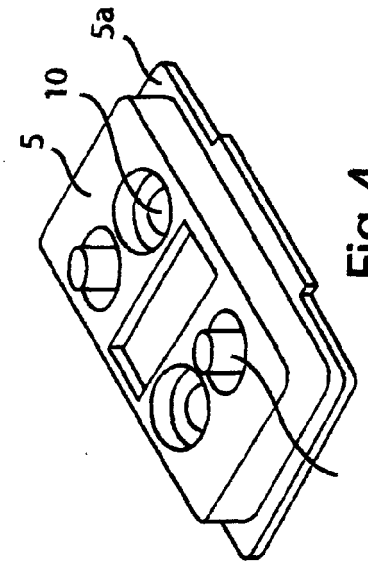


Fig. 4

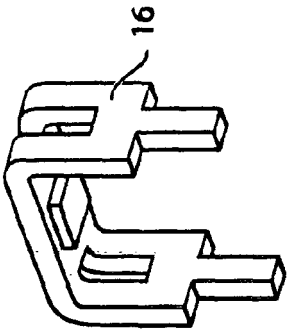


Fig. 5

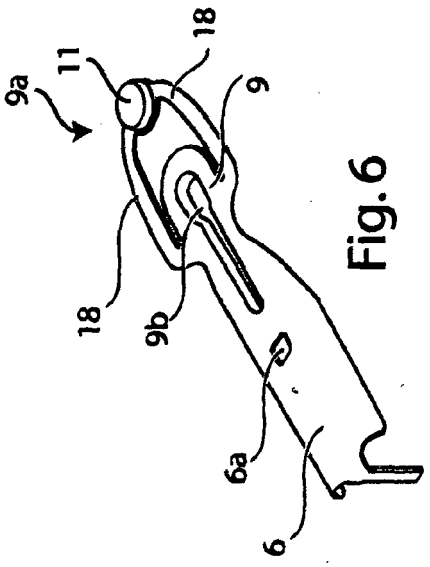


Fig. 6

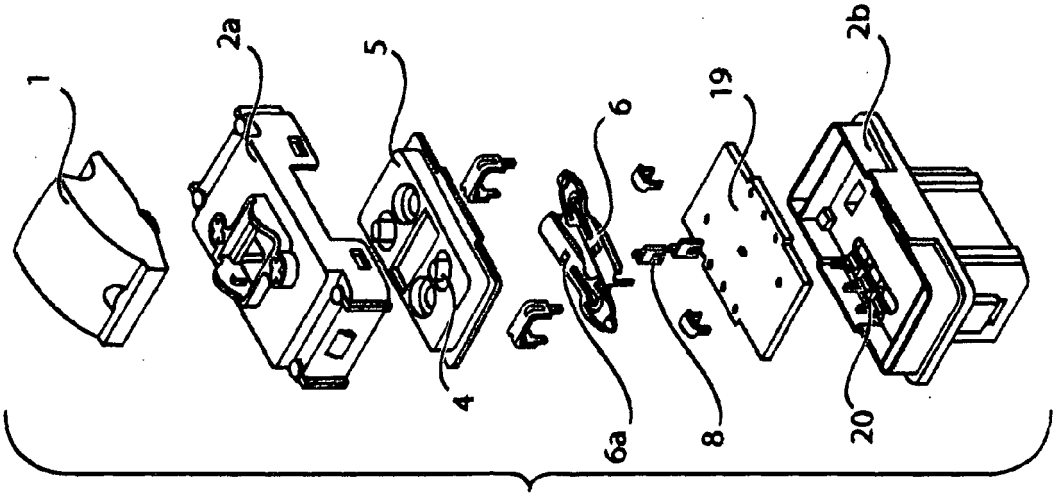


Fig. 3