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(54) An electrical double snap-action lamina switch

(57) Described herein is a double snap-action switch for controlling electrical apparatus, comprising a pushbutton and a container body, in which there move mobile contacts designed to perform a travel to reach both a first position of arrest with closing of a first part of fixed contacts of a printed circuit and a second position of arrest with closing of a second part of fixed contacts of said printed circuit; said mobile contacts being made of a metal lamina set between a snap-action element made of silicone material and the printed circuit.

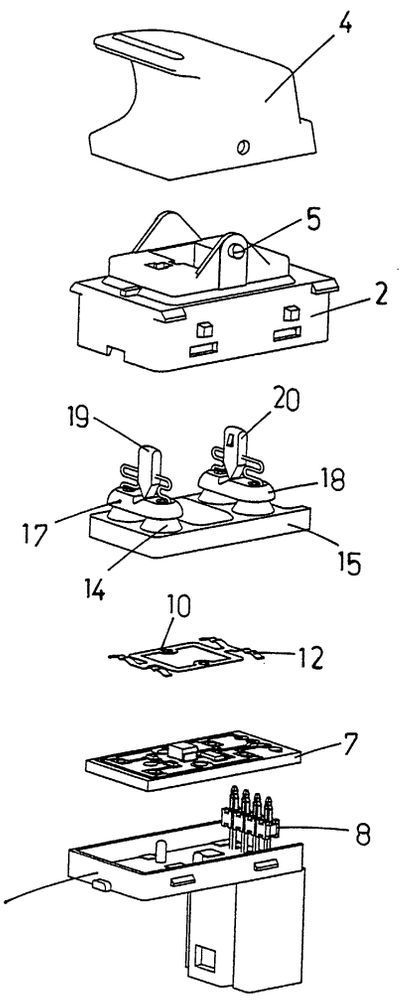

FIG.1

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Description

[0001] The present invention relates to an electrical double snap-action switch, for example for controlling car-window regulators or else other facilities present on a motor vehicle.

[0002] Many of the currently available snap-action switches are made up of an actuating push-button, which also has an aesthetic function, fitted on a supporting body by means of a hinge connection, which enables relative movement of rocking. The rocking motion of the push-button is converted into linear motion of two prods, which act on a rigid bar, which in turn impinges upon a pair of snap-action elements, also referred to as bubbles, made of silicone rubber. The hinge connection between the prods and the rigid bar enables a motion of rotation and translation of the aforesaid bar. The said motion is governed by the collapse of the silicone bubbles, which occurs in succession as a consequence of the fact that the point of contact between the prod and the rigid bar is not equidistant from the points of application of the reactions of the bubbles on said bar.

[0003] Embedded in pre-defined points within the silicone is electrically conductive material which enables closing of the contacts of the underlying printed circuit once the bubble has "snapped".

[0004] The switch of the prior art has, however, constructional features that increase the costs for its manufacture, both on account of the larger number of assembly operations, and on account of delicate and hence costly machining operations. In greater detail, the contacts in the bubble are obtained from mixing carbon dusts with silicone or else are co-moulded with the silicone. In either cases, high-technology processes are involved.

[0005] The purpose of the present invention is to provide a snap-action switch which will be inexpensive and will overcome the aforesaid drawback.

[0006] The above and other purposes and advantages are achieved by a snap-action switch for controlling electrical devices of a motor vehicle, comprising a push-button and a container body in which there move at least two mobile contacts designed to perform a travel to reach either a first position of arrest with closing of a first part of fixed contacts of a printed circuit or a second position of arrest with closing of a second part of fixed contacts of said printed circuit, said mobile contacts being moved by an elastic-snap-action element made of silicone material on which there acts a pair of rigid bars, each of which is controlled by a prod that acts on them in a misaligned way, causing the snapping in succession of the part of the elastic snap-action element set underneath the ends of said bars, with consequent closing of said fixed contacts, the said switch being characterized in that said mobile contacts are made with a metal lamina set between the snap-action element consisting of silicone material and the printed circuit.

[0007] There now follows a description of the structural and functional characteristics of a preferred but non-limiting embodiment of the switch according to the invention with reference to the attached drawings, in which:

- Figure 1 is an exploded side view of a switch according to the invention;
- Figures 2 and 3 are perspective views of two different embodiments of the lamina of the switch of the present invention;
- Figures 4a, 4b and 4c are partially cross-sectional views of the mechanism of the switch illustrated in Figure 1 in its three operating positions; and
- Figure 5 is an enlarged view of one of the points of contact between the lamina and the printed circuit of the switch according to the invention.

[0008] With reference to the figures, number 1 designates as a whole the outer body of a switch, for example for controlling the motors of car-window regulators, formed by a cover or lid 2 and by a base 3 and provided with an oscillating control button 4 connected, in 5, to the lid 2. The body 1 is fixed in position by being snapped on to a part of the passenger compartment of a motor vehicle (not illustrated). The push-button 4 can move between two positions for controlling, in the example illustrated, closing or opening of the car windows.

[0009] Located on the base 3 of the body of the switch are the printed circuit 7 and the connectors 8 for its connection to the electrical system. Anchored on the printed circuit, which is provided with special fixing pins, is a lamina 10. The latter is made of an elastic metal material, which is a conductor of electric current, and is made, starting from a plane metal strip, by means of a process of blanking and forming. The lamina 10 (see Figures 1 and 2), which has a substantially rectangular profile, presents, on the shorter sides, two arched strips per side, with at least one support 2 at the ends of each strip, and at least one central indentation 13 for each support.

[0010] A second embodiment 10a of the lamina 10 is illustrated in Figure 3. In the latter embodiment, the arched strips have been replaced by elastic bridges 12a, which are made at the four corners and perform the same function. Each indentation 13 is formed in a position such as to be located, when the switch is assembled, at a point corresponding to one of the silicone bubbles 14 made out of a single elastic element 15, referred to as "mat" in the specific terminology of the technical sector, set in a position overlying the lamina 10. The silicone bubbles have the function of providing the sensation of actuation of the switch. In particular, they follow a non-linear curve of the strength of the bubble versus the travel, the said curve rising up to the point where the bubble reaches an unstable geometrical condition, beyond which there occurs collapse with sudden reduction in the strength and consequent increase in the speed of motion of the system. In this way, the classic snap-action of the switch is obtained. A second function of the sili-

cone bubbles is to provide the compressive strength of the contact elements, in particular the contacts between the lamina 10 and the printed circuit 7, which is necessary for implementation of the electrical function of the switch.

[0011] At points corresponding to the indentations 13, there are made the points of contact of the lamina 10 on the printed circuit 7. They consist of a pad having a substantially circular shape 15a, with a hole 16 passing through the printed circuit, made at its centre. Both the pads and the holes of each point of contact are coated with electrically conductive material.

[0012] A pair of rigid bars 17 and 18, is set in a position overlying the mat, and each bar is supported on a pair of silicone bubbles on one and the same side of the mat so as to exert pressure on them as a result of the actuation of the oscillating control 4. The action of said control is transmitted to the rigid bars by means of a pair of prods 19 and 20, each associated to a single bar, in a point that is not equidistant from the points of application of the reactions of the silicone bubbles on the rigid bars, so that the linear motion of the prods pushed downwards (with respect to Figure 1) will be converted into a motion of rotation and translation of said rigid bars (see Figures 4a to 4c).

[0013] The prods 19 and 20 are connected to the rigid bars 17 and 18 by hinges, which, in one of the possible embodiments, are represented by flexible elements in the form of S-shaped springs 22.

[0014] The switch according to the invention functions in the way described hereinafter, with particular reference to Figures 1 and 4a, 4b, 4c.

[0015] When a pressure or a tensile stress is exerted on the push-button 4, causing its rotation about the fulcrum 5, a pressure is, in any case, exerted on the central portion of one of the two rigid bars 17, 18, by means of the prods 19, 20. In the case described with reference to Figures 4a to 4c, the bar subjected to the pressure moves downwards, starting from its resting position (Figure 4a). When it oversteps the first point of equilibrium, corresponding to the collapse of one of the bubbles, there occurs a first snap (Figure 4b), which brings the first contact of the lamina 10 to rest on the printed circuit 7 so closing the first control circuit. Proceeding in the action on the push-button, the rigid bar 17, 18 is further compressed and thus reaches the second point of collapse of the underlying bubble, bringing about the second snap, which brings the second contact of the lamina 10 to close the second control circuit on the printed circuit (Figure 4c).

[0016] The making of the electrical contact by means of the indentation 13 on the supports 12, enables, at the moment of "snapping" of the silicone bubble, mutual sliding of the surfaces of contact between the lamina and the printed circuit, i.e., a relative movement between the two parts, which enables a self-cleaning effect of the surfaces involved to be obtained, with consequent longer duration of efficient operation of the switch. The central through hole 16 moreover enables removal of any residual impurities that might result from the machining process or that may have been created during use from the surface of contact between the metal lamina and the printed circuit, the said contact being made on the edge and not on the flat surface.

Claims

1. A double snap-action switch for controlling electrical apparatus of a motor vehicle, comprising a push-button (4) and a container body in which there move mobile contacts (12) designed to perform a travel to reach both a first position of arrest, with closing of a first part of fixed contacts of a printed circuit, and a second position of arrest, with closing of a second part of fixed contacts of said printed circuit, said mobile contacts being moved by an elastic snap-action element made of silicone material (15), on which there acts a pair of rigid bars (17, 18) each controlled by a prod (19, 20), which acts on them in a misaligned way, causing the snapping in succession of the part of the elastic snap-action element set underneath the ends of said bars (17, 18), with consequent closing of said fixed contacts, the said switch being **characterized in that** said mobile contacts (12) are made with a metal lamina (10) set between the snap-action element made of silicone material and the printed circuit.

2. The switch according to Claim 1, **characterized in that** the metal lamina (10) has a substantially rectangular profile and has, on the shorter sides, two arched strips per side, with at least one support (12) at the ends of each strip and at least one central indentation (13) for each support.

3. The switch according to Claims 1 and 2, **characterized in that** made on the printed circuit (7) are points of contact for the supports of the lamina (10), made up of a pad of a substantially circular shape (15a), with a through hole (16) in the printed circuit, made in its centre, at points corresponding to said indentations (13).

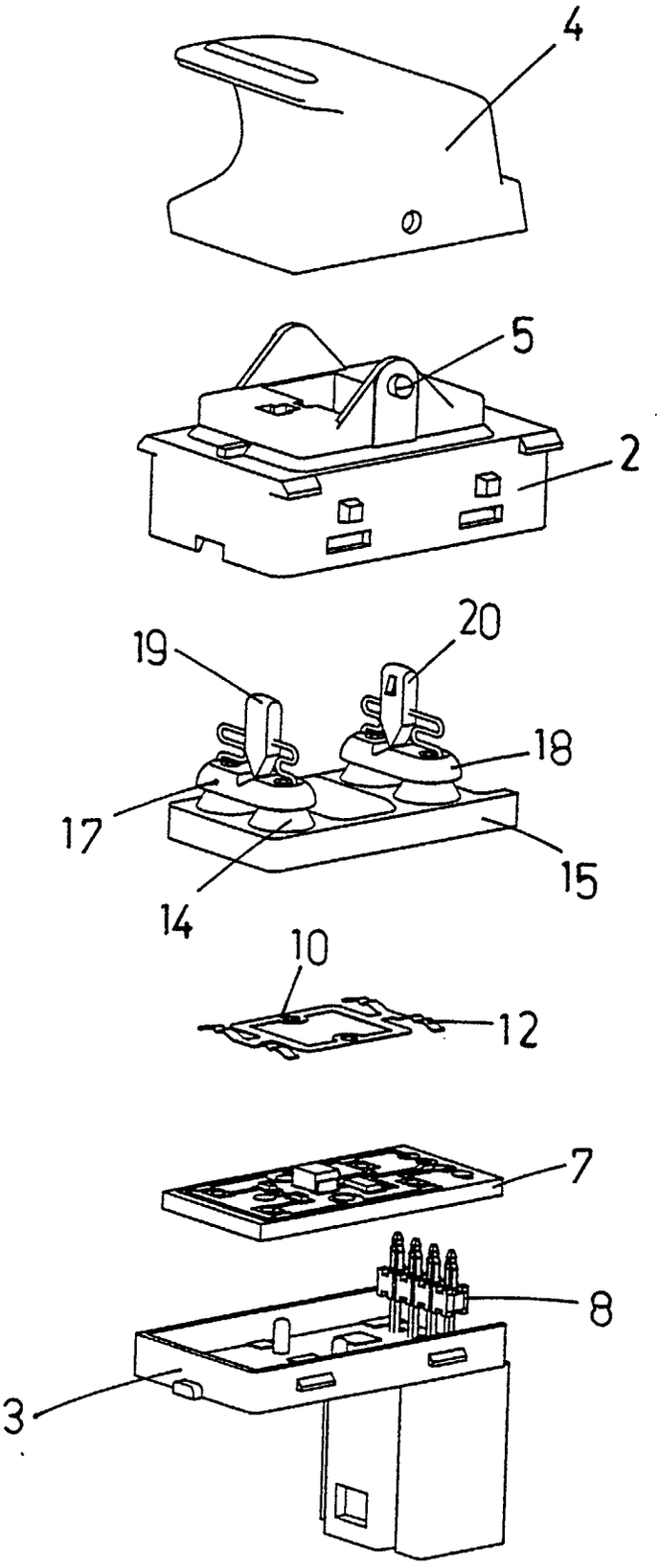
4. The switch according to Claim 3, **characterized in that** the points of contact and the holes are coated with electrically conductive material.

5. The switch according to Claims 1 to 3, **characterized in that** the contact between the lamina (10) and the printed circuit (7) is made on the edge of the holes (16).

6. The switch according to Claim 1, **characterized in that** the supports of the metal lamina (10a) are elastic bridges (12a) made at a point corresponding to

its corners.

FIG.1



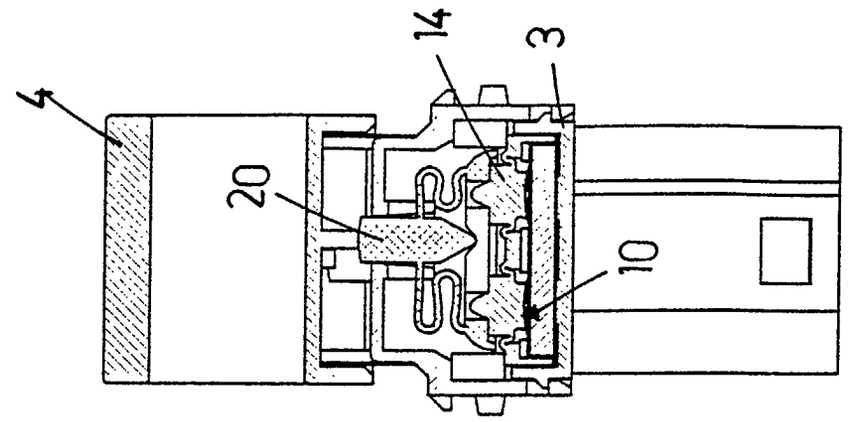


FIG.4c

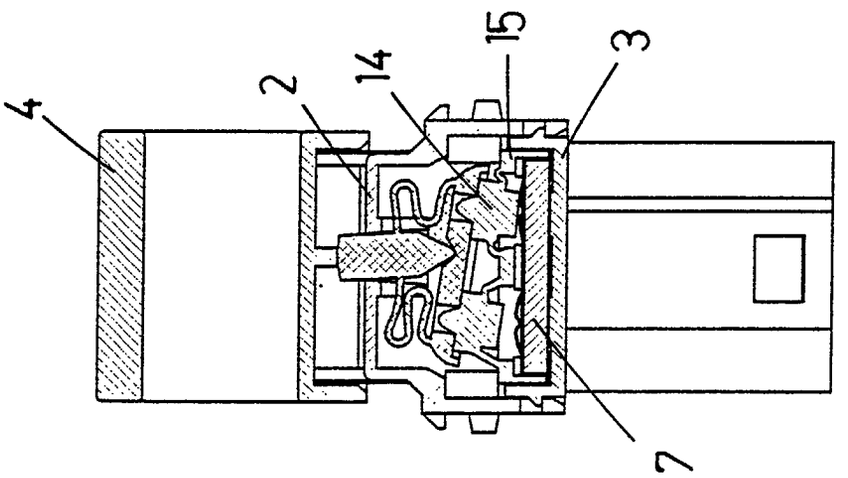


FIG.4b

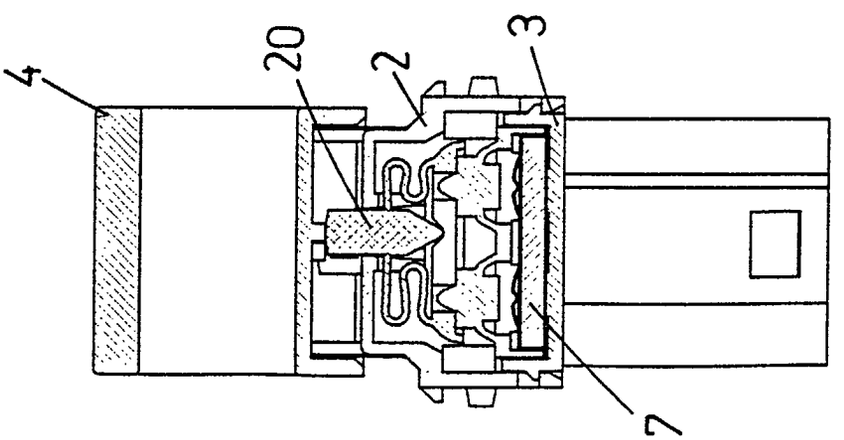


FIG.4a

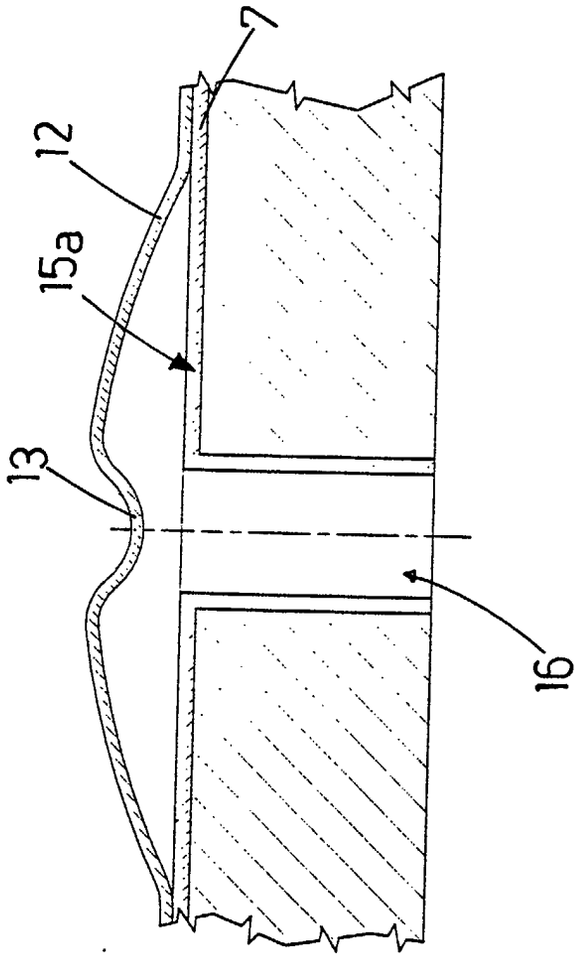


FIG.5

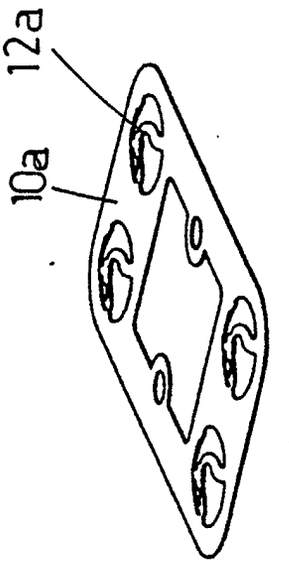


FIG.3

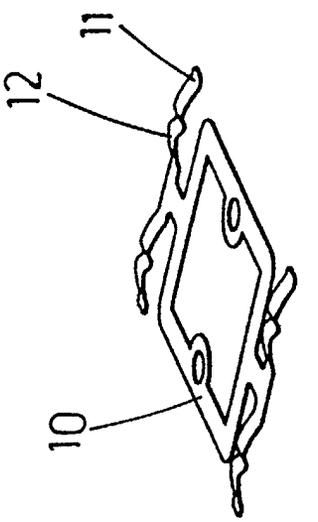


FIG.2