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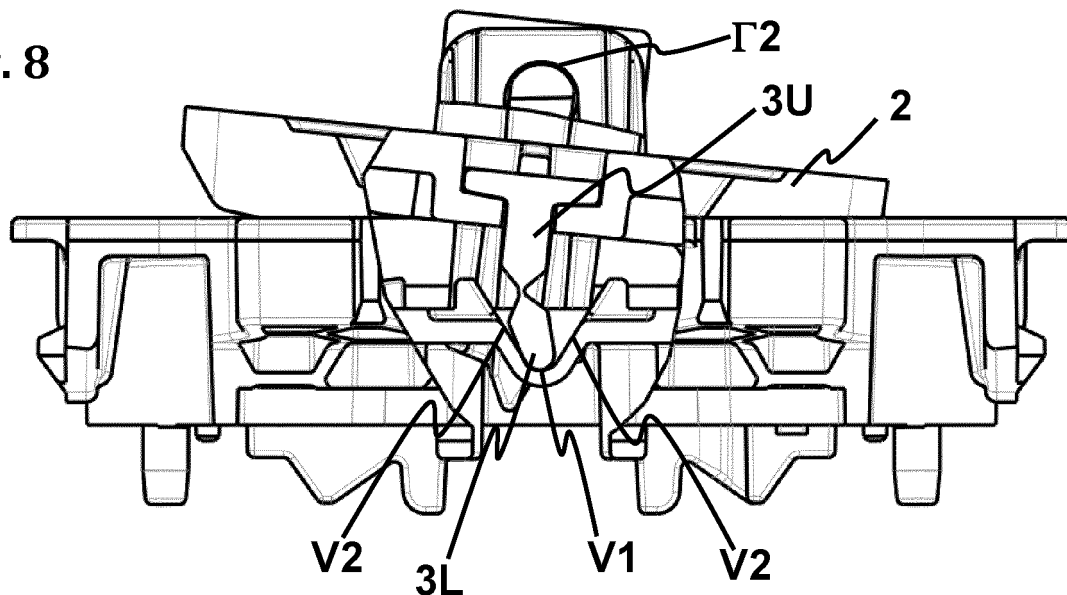
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(54) BISTABLE MECHANISM FOR SWITCH

(57) Bistable mechanism (M) for switch (S) comprising a base (1) for supporting a rotatable key (2), the base (1) comprising a groove (V) where a lower end (V1) is defined, the key (2) comprising a tab (3) having an upper end (32) attached to the key (2) and a lower end (31) leaning on the lower end (V1) of the groove, the tab (3)

comprising a central narrowing (33) thus defining a lower section (3L) that goes from the narrowing (33) to the lower end (31) so that the tab (3) constitutes a deformable element articulated in the narrowing (33) that provides a soft touch and an ergonomic behaviour.

Fig. 8**EP 4 202 964 A1**

Description

TECHNICAL FIELD

[0001] The present invention belongs to the specific sector of switches, and more specifically to the bistable mechanisms inserted in the switches, which usually comprise basically three components, a pivoting key (which can be directly the key that the user presses or to which a key cover is fixed), a base and a deformable element arranged between the base and the key, destined to provide the desired dynamics to the switch.

STATE OF THE ART

[0002] Known are in the art switches wherein the mechanism comprises a base for supporting a key and a key rotatable on an axis with respect to the base.

[0003] An objective with this type of device is their reliability during a high number of cycles, and also an ergonomic behaviour, that is to say that the dynamics are comfortable for the user.

[0004] In this case, three characteristics are sought, first that the behaviour is smooth, that is, that the forces involved are not high, that it is progressive, that there are no angular position where no forces are applied, (otherwise said, that it does not seem that the key is "loose") and finally that the extreme positions are well marked, which will normally correspond to the conducting and non-conducting configurations.

[0005] To satisfy this need, many mechanisms have been designed, among which those based on elastic bistables stand out, an example of which is the one that uses metal sheets or springs, mounted such that extreme positions are defined in which the bistable is less compressed, and a step position in which the bistable is in its maximum stress state.

[0006] An essential aspect of these mechanisms with a view to putting the present invention into context is the need that in the extreme contact configurations of the moving element that makes the contact, there must be a certain gap between the rocker and the contact element. This gap is designed to guarantee contact. If the switch is designed so that at the moment of electrical contact the rocker is in contact with the electrical contact, a slight misadjustment could cause the device to be inoperative. In other words, the effectiveness of the contact configuration will be left to the chance of manufacture or assembly. That is why this minimum gap must be guaranteed, which can be of the order of a tenth of a millimeter. The problem that this gap entails is that it translates for the rocker into an interval of positions (on each side or extreme position) that is of the order of millimeters, since although the gaps expressed in rotation degrees are of the same order, the rocker is much greater. Therefore, in these circumstances the user perceives that, in that interval, the key that is pressed is loose.

[0007] The present invention provides a new solution

that is optimal in relation to the three points mentioned, namely progressive behaviour, prevention of loose configurations and good definition of the extreme positions.

DESCRIPTION OF THE INVENTION

[0008] For overcoming the state of the art limitations, the present invention proposes a bistable mechanism for a switch, the mechanism comprising a base for supporting a key and a key rotatable with respect to the base on an axis, wherein the base comprises, under the key and arranged parallel to the axis, a groove, a lower end being defined in the groove, and the mechanism comprises a tab having an upper end attached to the key and a lower end leaning on the groove, the tab comprising a narrowing, so that a lower section is defined in the tab that goes from the narrowing to the lower end of the tab, so that the tab constitutes a deformable element articulated in the narrowing.

[0009] In some embodiments an upper section is defined in the tab that extends from the upper end of the tab to the narrowing.

[0010] In some embodiments, the length of the tab being, between its lower end and its upper end and in an uncompressed state, greater than the distance between the upper end of the tab and the lower end of the groove when the tab is installed and therefore in a compressed state, such that the tab is subjected to a compression when the key is in a central configuration between the two extreme configurations. In the present specification, the uncompressed state of the tab correspond to a state where the tab is not installed in the mechanism and therefore is not subjected to external stresses.

[0011] The lower end of the groove must be understood as the point of the groove farther from the axis of the key according to a direction perpendicular to the axis of the key in the direction of insertion of the switch in a wall, in other words, in a direction that includes the centre of the switch.

[0012] This solution satisfies the requirements for an ergonomic switch. The deformation possibilities of the articulated tab allow it to be progressively compressed and correctly stabilize the key in its extreme positions. In particular, with the claimed geometry, the tab can be moulded from a plastic material, which offers deformation possibilities that metal bistable tabs do not allow. It also offers a better feel than metal bistables, as has been practically verified. The tab according to the invention is, on the one hand, progressive, and on the other hand, it allows the stable configurations to be clearly established. With a known tab of the metal type and of constant section, that is bistable, the extreme positions are not so marked with respect to the unstable central configuration. The articulated tab can provide a higher potential energy in the central configuration, which better distinguishes the extreme configurations.

[0013] In some embodiments, the distance from the narrowing to the axis of rotation of the key is greater than

the distance from the narrowing to the lower end of the groove, thus allowing a higher compression of the tab but avoiding high stress on the narrowing that could conduct to a misalignment of the tab on the narrowing.

[0014] In some embodiments, the groove and the lower end of the tab are rounded.

[0015] In some embodiments, the groove and the lower end of the tab have a complementary contour.

[0016] In some embodiments, the groove is V-shaped, such that two planar surfaces project from both sides of the groove, the surfaces forming an angle therebetween, the angle has a value such that in the extreme positions of the key, the sides of the lower section of the tab do not rest on the planar surfaces. The two planar surfaces are projecting from the groove such that they don't affect to the function of the tab. In some embodiments the groove has any other shape in which a bottom of the groove is rounded and complementary with the contour of the lower end of the tab.

[0017] In some embodiments, in any position of the key between the two extreme positions of the key, the tab is compressed axially. In this way the key is stable in the extreme on/off configurations.

[0018] Preferably, the tab is made of an elastic/ plastic element. Preferably, before installing it in the mechanism, the tab is subjected to a previous treatment consisting in bending it in both directions such that areas of the narrowing surpass the elastic limit and enters in a plastic zone in the tension-deformation diagram. If this previous treatment is not carried out, the first uses of the mechanism will lead parts of the narrowing to also enter the plastic zone, but it will take longer. In any case, after a number of cycles, the tab will have a plastic behaviour in the vicinity of the narrowing.

[0019] Either way, In any case, the geometry of the tab allows it to have a plastic behavior in the narrowing area, so that, especially in extreme configurations, the plastic behavior will prevail over the elastic. That is, at the extreme positions the tab will not tend to recover the original state and to bring the key to the center, which would occur with a tab with a preponderant elastic behavior.

[0020] An advantageous effect of the invention is that the functions of facilitating a soft touch (therefore ergonomic and pleasant to the touch) and of stabilizing the key in its extreme positions are separated. The softening function is carried out by the tab with its geometry and plastic capabilities. The stabilization function is carried out in another part of the mechanism, specifically the elastic recovery elements (i.e. springs) that act on another part of the key, especially in its mechanical link with the mobile contact elements. Said in other words, the tab can be subjected to a compression in the intermediate position provoking an elastic deformation. But, at the extreme positions of the key, the elastic deformation of the lower section and the upper section if it is present is minimum and only the plastic deformation of the narrowing takes place. Indeed, at the ends, traction will occur on the outermost surface of the tab narrowing, while com-

pression will occur on the innermost surface. By innermost surface it is understood the surface of the articulation or narrowing of the tab that will be at that moment in the concave side of the articulated tab (by outermost surface it is then understood the surface of the articulation or narrowing of the tab that will be at that moment in the convex side of the articulated tab - for example in Fig. 5 the traction will occur at the left of the narrowing 33, the compression at the right - In Fig 6, just the opposite). Obviously, in each extreme position, the surfaces that are compressed or tensioned are reversed. Therefore, the person skilled in the art should dimension the tab so that at least near these external surfaces mainly plastic behaviour is achieved, which will allow the key and/ or rocker to be smoothly stabilized in the intervals where it could otherwise be loose.

[0021] In some embodiments, the tab is made of polypropylene homopolymer. It has been proven in practice that this material is especially adapted to the design of the tab narrowing, that is to say that it has the desired elastic and plastic behaviour. Besides, it is a material especially suitable for the purposes of the invention, as it is a material that reliably allows a large number of cycles of use, while maintaining its plastic properties.

[0022] In some embodiments, the tab has a mineral load, such that it has an increased stiffness.

[0023] Depending on the mineral charge contained in the polymer, it is possible to regulate the stiffness of the articulated tab, so that depending on the application, the smoothness of the switch can be adjusted.

[0024] In some embodiments, the upper end of the tab is T shaped, and the key has a complementary housing for the T-shaped end, which allows a good anchoring of the tab in the rocker.

[0025] In some embodiments, the upper end of the tab is integrally formed with the key, such that the narrowing and the lower section of the tab project from the key. In some of this embodiments an upper section projects from the key, continued by the narrowing and the lower section of the tab.

[0026] In some embodiments, the key is made of a plate, and two lateral extensions upwardly oriented and provided each with a circular protrusion, such that the upper end of the tab is arranged below the axis of rotation of the key.

[0027] In some embodiments, the base has two upper extensions each facing a lateral extension of the key and provided with an elongated groove, each elongated groove having in their upper end a semicircular shape for receiving the circular protrusions.

[0028] In some embodiments, the position of the circular protrusion and the elongated groove can be reversed, that is the elongated groove placed in the key, while the circular protrusions are part of the base.

[0029] In some embodiments, the base is made of a lower body enclosing electrical contacts and comprising connection levers and an upper cover comprising the groove.

[0030] In some embodiments, the material forming the narrowing is in the plastic zone of the tension deformation diagram. In other words, the tab has not an elastic behaviour (or it is minimum, such that the plastic forces prevail) when it is in its extreme angled configurations, and does not drive the key towards the center position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] To complete the description and in order to provide for a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate an embodiment of the invention, which should not be interpreted as restricting the scope of the invention, but just as an example of how the invention can be carried out. The drawings comprise the following figures:

Figure 1 shows a perspective of the switch in which the key is in an extreme position, and where connection levers for external cables are seen.

Figure 2 shows the key and the deformable tab.

Figure 3 shows, sectioned along a longitudinal plane, the base.

Figure 4 is a perspective of the deformable tab.

Figures 5 and 6 are sectional elevation views of the deformable tab, in configurations that could correspond to its extreme positions.

Figure 7 shows the effect of the placement of the narrowing in the compression of the tab, comparing the location of the narrowing closer to the middle point between the axis of rotation of the key and the groove and in a location where the narrowing is displaced closer to the lower end of the tab.

Figures 8 to 10 are sections that allow us to appreciate how the deformable tab of the switch of the invention works.

DESCRIPTION OF A WAY OF CARRYING OUT THE INVENTION

[0032] In FIG. 1, according to an embodiment, a bistable mechanism M for switch S is shown, wherein the base 1 is made of a lower body 12 enclosing electrical contacts and comprising connection levers L. The lower body 12 is covered by an upper cover 11.

[0033] The base 1 supports a key 2 rotatable with respect to the base 1 on an axis Γ .

[0034] As shown in figures 3 or 8 to 10, the base 1 comprises, under the key 2 and arranged parallel to the axis Γ , a groove V. By groove V it is to be understood that a concavity is defined for the purposes explained below.

[0035] This groove V has a lower end V1, this lower end V1 must be understood as the point of the groove farther from the key 2 according to a direction $\Gamma 2V$ (represented in FIG. 9). The direction $\Gamma 2V$, in the present specification, is the direction perpendicular to the axis of rotation in the direction of insertion of the switch in a wall, in other words in a direction that includes the centre of the switch. In FIG.9, this direction is the projection of a symmetry plane of the mechanism.

[0036] The mechanism 1 comprises a deformable tab 3 having an upper end 32 attached to the key 2 and a lower end 31 leaning on the groove V. The deformable tab 3, as shown in FIGS. 4 to 6, comprises a narrowing 33 that can be in any position of the tab between the upper end 32 and the lower end 31, so that a lower section 3L is defined that goes from the narrowing 33 to the lower end 31 of the deformable tab 3.

[0037] In some embodiments an upper section 3U can be defined on the tab that extends from the upper end 32 to the narrowing 33. This upper section 3U can have any length and even could not exist. In this case the narrowing projects directly from the key 2.

[0038] The degree of compression of the narrowing can be adjusted by the relative distances from the axis of rotation of the key to the narrowing and the length of the lower section L3 of the tab, or in other words, the placement of the narrowing in relation to the distance (**Raxe-sup**, **Raxe-inf**) between the axis of rotation of the key and the narrowing and the distance (**Rgroove-sup**, **Rgroove-inf**) between the narrowing and the end of the groove. Figure 7 shows that by arranging the narrowing closer to the rotation axis of the key, less compression is achieved than by arranging it closer to the lower end of the tab, since in the latter case there is a greater overlap of the circles representing the path of the narrowing for each one of the parts, from the axis of the key to the narrowing and from the narrowing to the lower end of the tab, if they were independent.

[0039] Figure 7 compares the degree of compression that can be achieved according to the position of the narrowing 33, that is, according to the relationship between the radius **Rgroove** that goes from the lower end of the groove to the narrowing and **Raxe** that goes from the rotation axis of the key to the narrowing. The intersecting arcs of the circles described by the radii **Rgroove-inf** and **Raxe-inf** represented in the lower part of the figure 7, correspond to the preferred embodiment in which the narrowing is closer to the groove than to the axis of rotation of the key 2, and gives an overlap **Overlap-inf**.

[0040] And it can be seen that this **Overlap-inf** is clearly greater than the **Overlap-sup** that would be achieved if the narrowing were positioned in a more equidistant part between axis of rotation of the key and groove, that is, corresponding to the narrowing placed at the overlap of the intersecting arcs of the circles described by the radii **Raxe-sup** and **Rgroove-sup**.

[0041] Preferably, the length L3 of the tab 3, between its lower end 31 and its upper end 32 and in an uncon-

pressed state, is greater than the distance L2V between the upper end 32 of the tab and the lower end V1 of the groove V in an installed condition, so that the tab 3 constitutes a deformable element articulated in the narrowing 33. Therefore, in an installed condition, the length L3 will be shorter than in a compressed state.

[0042] As shown for example in FIG. 8, the bottom of the groove V and the lower end 31 of the tab 3 are rounded.

[0043] The groove V is V-shaped, such that two planar surfaces V2 are defined in both sides of the groove V, the surfaces V2 forming an angle α therebetween, the angle α has a value such that in the extreme positions of the key 2, the sides of the lower section 3L of the tab 3 do not rest on the planar surfaces V2.

[0044] In this way, it is guaranteed that the tab 3 of the bistable mechanism will not be forced, in the sense that shear stresses will not develop into a break in its articulation, which will guarantee a longer life.

[0045] It should be noted that the V-shaped side walls are a constructive option, allowing easy centering when mounting the switch. In no case are these walls necessary for the correct operation of the deformable tab. The important thing for the operation of the deformable tab is that its end rests in a concavity.

[0046] In any position of the key 2 between the two extreme positions of the key 2, the tab 3 is compressed axially, such that there are not loose configurations of the key.

[0047] The extreme positions of the key will be determined by points or support surfaces on the base, coinciding with the ends of the key, to reduce pressures. In abutting configurations of the key on the base, the deformable tab 3 will be in a bent configuration, but without actually touching the walls adjacent to the groove.

[0048] In the embodiment shown, the narrowing 33 is displaced with respect to the middle point of the tab 3 between the lower end 31 and the upper end 32, the upper section 3U of the tab 3 being longer than the lower section 3D of the tab 3. Nevertheless the upper section 3U of the tab 3 can have any length and even the upper section 3U could not exist at all. But the lower section 3L of the tab 3 needs to have at least a minimum length from the narrowing to the lower end 31 of the tab 3, enough to allow demoulding and to perform an automatized treatment that bends the tab in both directions such that areas of the narrowing enters a plastic zone in the tension-deformation diagram.

[0049] Also, as shown in the figures, the upper end 32 of the deformable tab 3 is T shaped, and the key 2 has a complementary housing 23 for the T-shaped end 32, thus providing a good anchoring of the tab in the key.

[0050] Now regarding the assembly of the key and the base, the key 2 is made of a plate 21, and two lateral extensions 22 upwardly oriented and provided each with a circular protrusion $\Gamma 1$, such that the upper end 32 of the tab 3 is arranged below the axis Γ of rotation of the key 2. The base 1 has two upper extensions 13 each facing

a lateral extension 22 of the key and provided with an elongated groove 14, each elongated groove having in their upper end a semicircular shape $\Gamma 2$ for receiving the circular protrusions $\Gamma 1$.

5 [0051] With respect to the absolute dimensions, for a conventional switch, a distance from the axis of rotation of the key to the narrowing of about 9mm is foreseen, and a distance from the upper part of the circular protrusion $\Gamma 1$ to the groove of about 13 -14 mm is foreseen, and a state of maximum compression of the tab as it passes through the position intermediate between 1 and 2%.

10 [0052] As shown for example in 1, the axis Γ of rotation of the key is as close as possible to the rotation of the key to reduce the gaps between the key or the key protector and an external frame of the switch. Said in other words, the central section of the key surface is not displaced in the rotation.

15 [0053] In this text, the term "comprises" and its derivations (such as "comprising", etc.) should not be understood in an excluding sense, that is, these terms should not be interpreted as excluding the possibility that what is described and defined may include further elements, steps, etc.

20 [0054] The invention is obviously not limited to the specific embodiment(s) described herein, but also encompasses any variations that may be considered by any person skilled in the art (for example, as regards the choice of materials, dimensions, components, configuration, etc.), within the general scope of the invention as defined in the claims.

Claims

- 35 1. Bistable mechanism (M) for a switch, the mechanism comprising a base (1) for supporting a key (2) and a key (2) rotatable with respect to the base (1) on an axis (Γ), **characterized in that** the base (1) comprises, under the key (2) and arranged parallel to the axis (Γ), a groove (V), a lower end (V1) being defined in the groove (V), and the mechanism (M) comprises a tab (3) having an upper end (32) attached to the key (2) and a lower end (31) leaning on the groove (V), the tab (3) comprising a narrowing (33) so that a lower section (3L) is defined that goes from the narrowing (33) to the lower end (31) of the tab (3) so that the tab (3) constitutes a deformable element articulated in the narrowing (33).
- 40 2. Mechanism according to claim 1, wherein an upper section (3U) is defined in the tab (3) that extends from the upper end (32) to the narrowing (33).
- 45 3. Mechanism according to any of the previous claims, wherein the distance from the narrowing (33) to the axis (Γ) of rotation of the key (2) is greater than the distance from the narrowing (33) to the lower end

(V1) of the groove (V).

4. Mechanism according to any of the previous claims, wherein the bottom of the groove (V) and the lower end (31) of the tab (3) are rounded. 5
5. Mechanism according to any of the previous claims, wherein the bottom of the groove (V) and the lower end (31) of the tab (3) have a complementary contour. 10
6. Mechanism according to any of the previous claims, wherein the groove (V) is V-shaped, such that two planar surfaces (V2) are defined in both sides of the groove (V), the surfaces (V2) forming an angle (a) therebetween, the angle (a) has a value such that in the extreme positions of the key (2), the sides of the lower section (3D) of the tab (3) do not rest on the planar surfaces (V2). 15
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7. Mechanism according to claim 5, wherein in any position of the key (2) between the two extreme positions of the key (2), the tab (3) is compressed axially.
8. Mechanism according to any of the previous claims, wherein the tab (3) is made of polypropylene homopolymer. 25
9. Mechanism according to claim 8, wherein the tab (3) has a mineral load, such that it has an increased stiffness. 30
10. Mechanism according to any of the preceding claims wherein the upper end (32) of the tab (3) is T shaped, and the key (2) has a complementary housing (23) for the T-shaped end (32). 35
11. Mechanism according to any of claims 1 to 9, wherein the upper end (32) of the tab (3) is integrally formed with the key (2). 40
12. Mechanism according to any of the previous claims, wherein the key (2) is made of a plate (21), and two lateral extensions (22) upwardly oriented and provided each with a circular protrusion (r_1), such that the upper end (32) of the tab (3) is arranged below the axis (r) of rotation of the key (2). 45
13. Mechanism according to claim 12, wherein the base (1) has two upper extensions (13) each facing a lateral extension (22) of the key and provided with an elongated groove (14), each elongated groove having in their upper end a semicircular shape for receiving the circular protrusions (r_1). 50
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14. Mechanism according to any of the previous claims, wherein the base is made of a lower body (12) enclosing electrical contacts and comprising connec-

tion levers (L) and an upper cover (11) comprising the groove (V).

15. Mechanism according to the previous claims, wherein the material forming the narrowing (33) is in the plastic zone of the tension deformation diagram.

Fig. 1

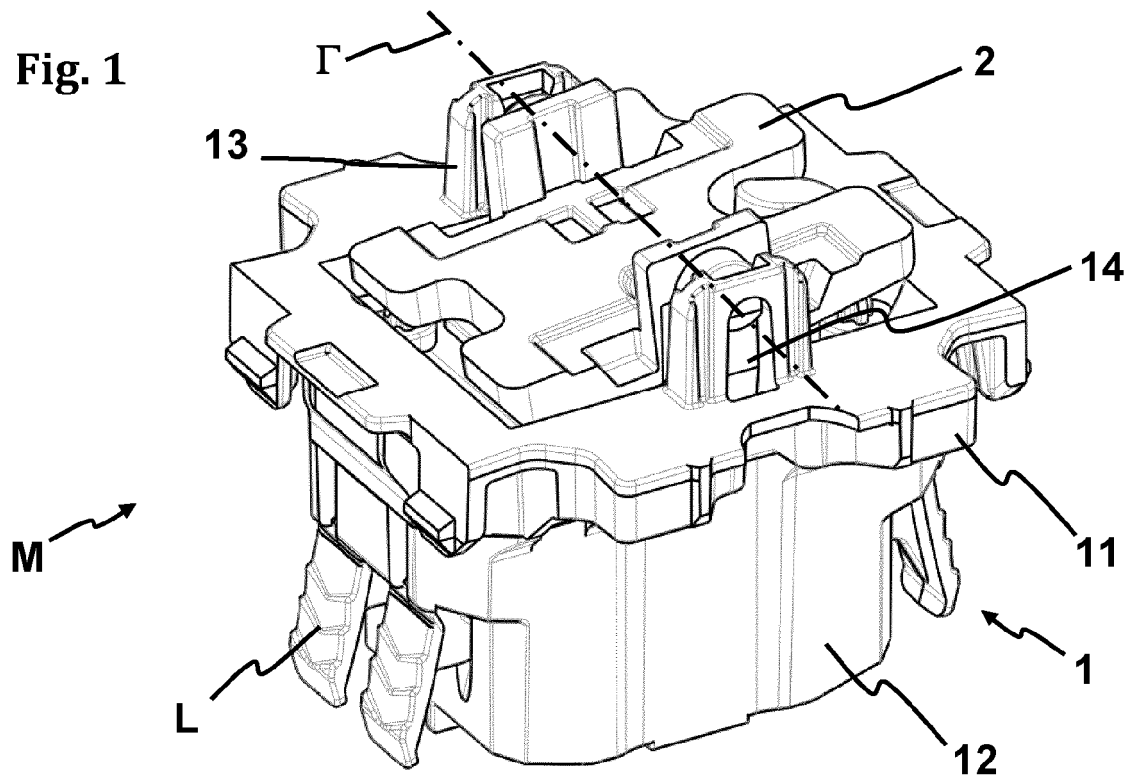


Fig. 2

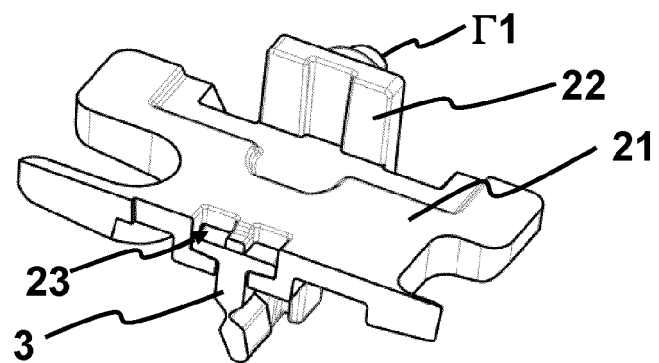


Fig. 3

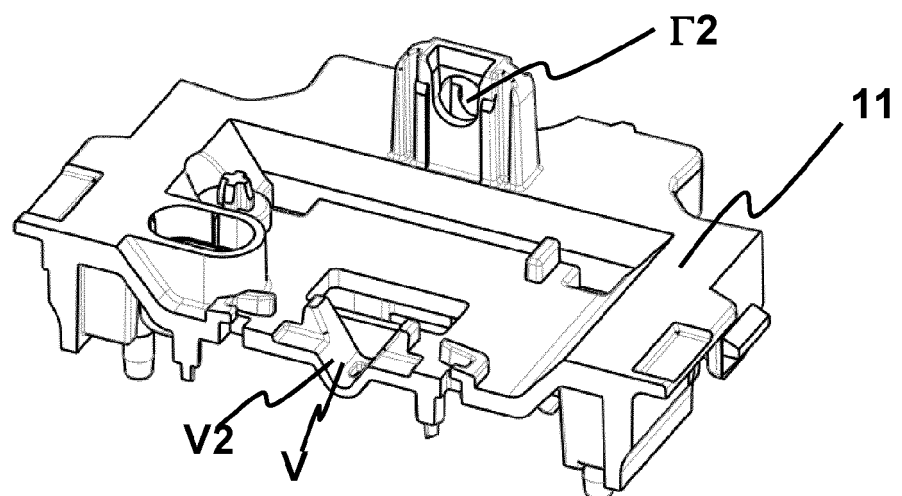


Fig. 4

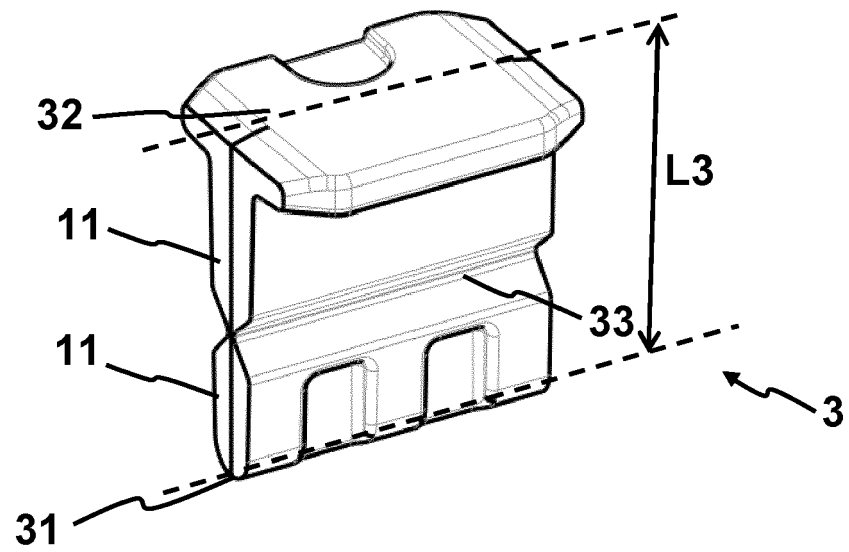


Fig. 5

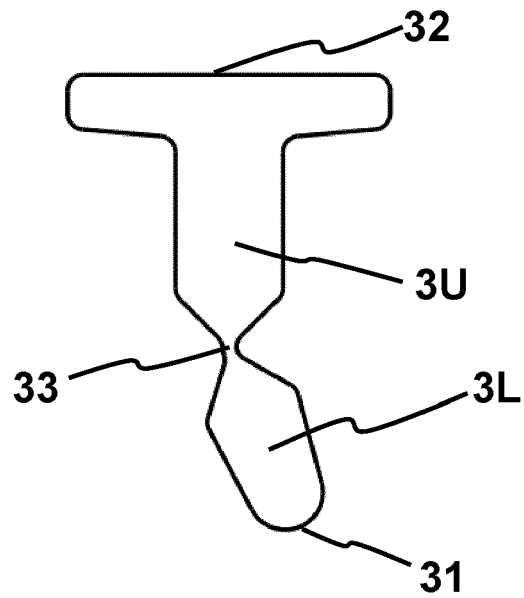
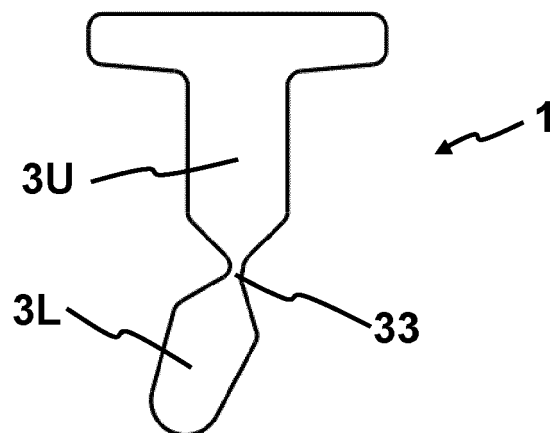


Fig. 6



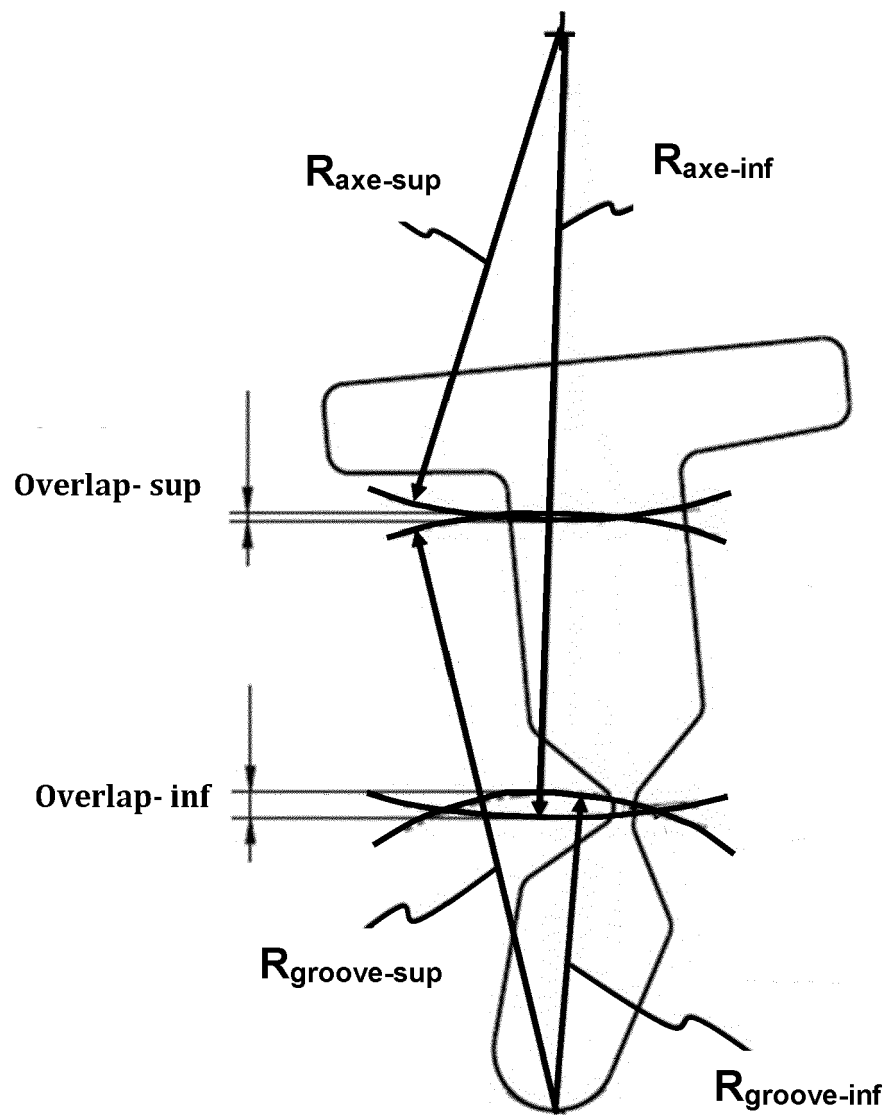


Fig. 7

Fig. 8

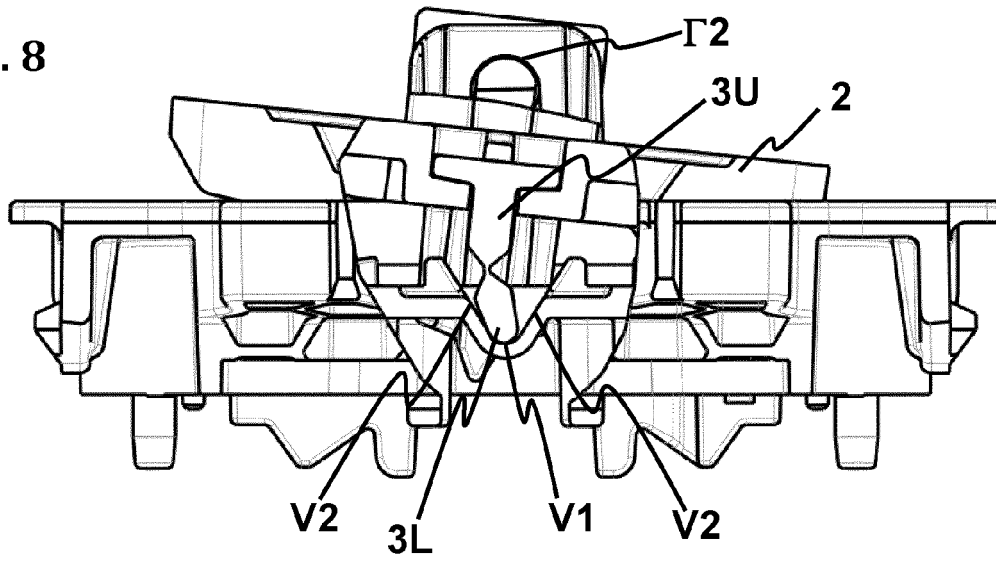


Fig. 9

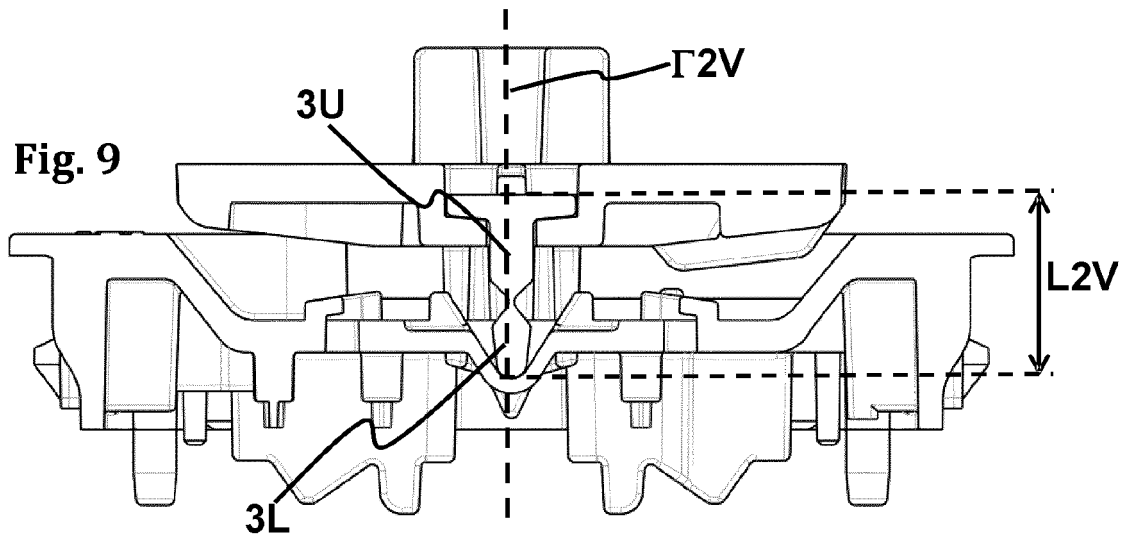
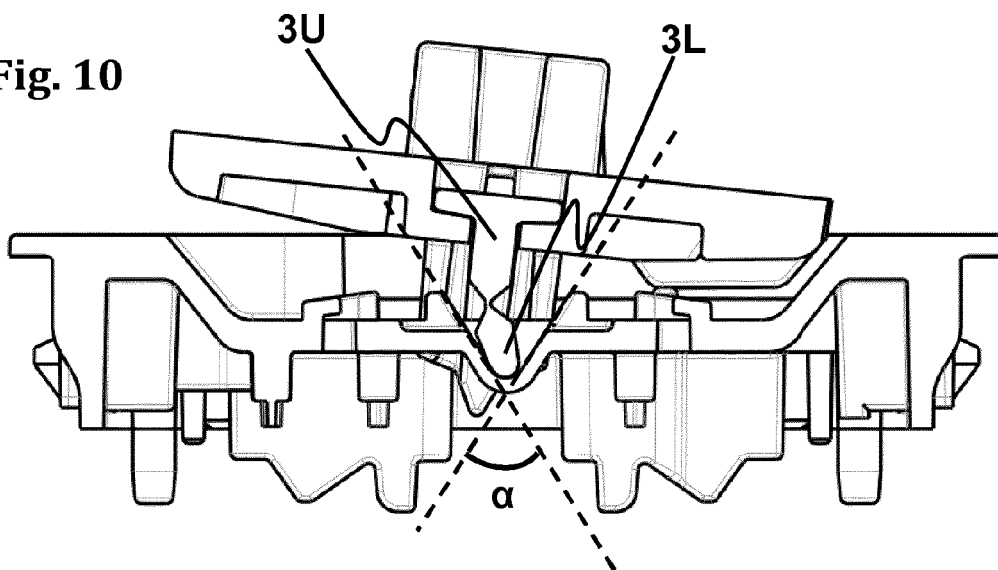


Fig. 10





EUROPEAN SEARCH REPORT

Application Number

EP 21 38 3227

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	FR 2 711 841 A1 (ARNOULD APP ELECTR [FR]) 5 May 1995 (1995-05-05) * page 6, line 8 - page 8, line 4; figure 1 *	1-15	

TECHNICAL FIELDS
SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

1

Place of search

Munich

Date of completion of the search

3 June 2022

Examiner

Pavlov, Valeri

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82