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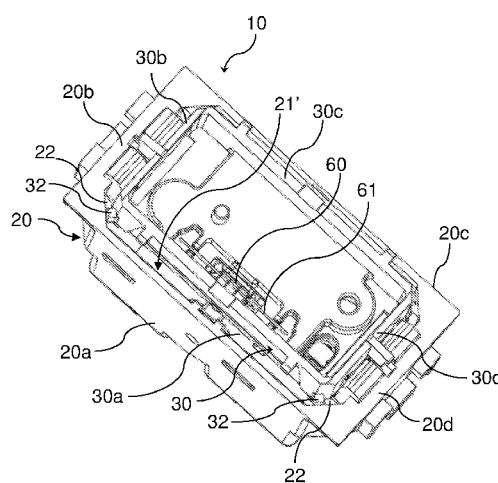


FIG. 3

(57) Abstract: 1. A push button operated circuit breaker (10) with rocking control member including: a case (20) made of electrically insulating material, having a bottom wall (21), lateral walls (20a, 20b, 20c, 20d) being joined to the bottom wall (21) and an open side (21') opposite to the bottom wall (21); a button (30) that can be operated to command an electrical switching of the circuit breaker (10) and having a body provided with lateral walls (30a, 30b, 30c, 30d) crossing said open side (21'), the push button (10) being adapted to slide with respect to the case (20) along a sliding axis (Z-Z), between a forward position and a backward position; a rocking control member (70) adapted to control an electrical switching; a pressure transmitting member (60) being rotatably fastened to the body of the push button (30) and adapted to rotate with respect to a rest angular position around a rotation axis (A1-A1); an elastic element (61) adapted to bring back the pressure transmitting member (60) in the rest angular position after its rotation; characterized in that the above-mentioned elastic element is, or includes, a wire spring (61).

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TITLE

"A button operated circuit breaker with rocking control member"

FIELD OF THE INVENTION

[0001] The present description refers to the technical field of the electrical installations and, more particularly, it concerns a push button operated circuit breaker with rocking control member.

STATE OF THE ART

[0001a] A reference herein to a patent document or any other matter identified as prior art, is not to be taken as an admission that the document or other matter was known or that the information it contains was part of the common general knowledge as at the priority date of any of the claims.

[0001b] Where any or all of the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification (including the claims) they are to be interpreted as specifying the presence of the stated features, integers, steps or components, but not precluding the presence of one or more other features, integers, steps or components.

[0002] Push button operated circuit breakers are known wherein the control of the electrical switching occurs by means of a rocking control member. US 4,748,298 discloses a lever operated switch.

[0003] European patent EP1584096 discloses a push button operated circuit breaker including a supporting structure made of insulating material, or case, having the shape of a box and defining a recessed compartment for housing and for supporting the electromechanical components being part of the circuit breaker. The case has an open side. The circuit breaker also includes a push button slidingly coupled to the case by means of guide elements in order to close the open side. The

mechanical coupling between the push button and the case allows a relative and guided sliding of the push button with respect to the case along a sliding axis. Such sliding is necessary to command by means of the push button an electrical switching of the circuit breaker. A pressure of the push button determines an advancement of the push button with respect to the case. A release of the push button determines a backward movement of the push button with respect to the case. The push button therefore moves between a forward position and a backward position, that represent two opposite stopping positions of the push button. The push button is coupled to a rotatable pressure transmitting member and the circuit breaker includes a rocking control member that controls the switching. The pressure transmitting member is adapted to rotate into two opposite directions starting from an angular resting position and the push button includes at least an elastic element adapted to bring the pressure transmitting member back to the angular resting position after one rotation. The elastic element is for example implemented by means of one or more foil springs, for example made of metal foil, folded and sheared off. By pushing the push button, the rotatable pressure transmitting member contacts the rocking control member in order to make it rotate. This rotation, in its turn, is such that it moves a mobile contact element in order to determine an electrical switching.

[0004] In the prior art push button operated circuit breakers, the aforesaid elastic element opposes a certain resistance during the pressure of the push button starting from a certain point on during the push button stroke, particularly when the pressure transmitting member contacts the rocking control member. Such resistance is due to the fact that the elastic elements opposes to the pressure transmitting member rotation. This resistance determines the user's feeling of lack of sliding fluidity while pushing the push button.

[0005] It is therefore felt the need for implementing a push button operated circuit breaker with a rocking control member being such as to reduce the resistance opposed by the elastic element associated to the push button pressure transmitting member.

[0006] It would therefore be desirable to make available a push button operated circuit breaker with rocking control member being such as to fulfil the above described need with reference to the prior art circuit breaker.

[0006a] A first aspect of the present invention provides a push button operated circuit breaker with rocking control member including:

- a case made of electrically insulating material, having a bottom wall, lateral walls being joined to the bottom wall and an open side opposite to the bottom wall;
- a push button that can be operated to command an electrical switching of the switch and having a body provided with lateral walls crossing said open side, the push button being adapted to slide with respect to the case along a sliding axis, between a forward position and a backward position;
- a rocking control member adapted to control an electrical switching;
- a pressure transmitting member being rotatably constrained to the body of the push button and adapted to rotate with respect to a rest angular position around a rotation axis;
- an elastic element adapted to bring back the pressure

transmitting member in the rest angular position after its rotation;

wherein:

- the above-mentioned elastic element is, or includes, a wire spring;
- the body of the push button includes a pass-through opening, crossed by the pressure transmitting member, thereby the wire spring is arranged on one side of the pass-through opening together with at least one a part of a central portion of the pressure transmitting member, while the remaining part of the pressure transmitting member is arranged on the other side of said pass-through opening.

[0007] Preferred and advantageous embodiments of the aforesaid circuit breaker are defined in the enclosed dependent claims.

[0008] The invention shall be better understood from the hereinafter detailed description of particular embodiments given merely by way of example but not limited to, with

embodiments given merely by way of example but not limited to, with reference to the enclosed drawings briefly described in the following paragraph.

BRIEF DESCRIPTION OF THE DRAWINGS.

5 [0009] Figure 1 shows a perspective view of one embodiment of a push button operated circuit breaker with rocking control member including a case, a button slidably constrained to the case and a key coupled to the push button.

10 [0010] Figure 2 shows a side view of the push button operated circuit breaker of Figure 1.

[0011] Figure 3 shows a further perspective view of the circuit breaker of Figure 1 from which the key has been removed.

15 [0012] Figure 4 shows a top view of the circuit breaker case of Figure 1 from which all the components contained inside the case have been removed.

[0013] Figure 5 shows a top view of the push button of the circuit breaker of Figure 1.

20 [0014] Figure 6 shows a perspective view from below of the push button of the circuit breaker of Figure 1.

[0015] Figure 7 shows a partial cross-section perspective view of the switch of Figure 1, from which the key and some of the components contained inside the case have

been removed.

[0016] Figure 8 shows a perspective view of the case of the circuit breaker of Figure 1, wherein some of the components contained inside the case are visible.

5 [0017] Figure 9 shows a partial cross-section perspective view of an enlarged part of the circuit breaker of Figure 1.

10 [0018] Figure 10 shows a further partial cross-section perspective view of an enlarged part of the circuit breaker of Figure 1.

[0019] Figure 11 shows a side view of the circuit breaker of Figure 1 from which the key has been removed.

15 [0020] Figure 12 shows a partial cross-section perspective view of the case of the circuit breaker of Figure 1, wherein a supporting fulcrum inserted in the case is visible.

[0021] Figure 13 shows a partial cross-section side view of the case and of the supporting fulcrum of Figure 12.

20 [0022] Figure 14 shows a perspective view of the supporting fulcrum of Figures 12 and 13.

[0023] Figure 15 shows a pressure transmitting member of the push button of the circuit breaker of Figure 1.

[0024] Figure 16 shows a further perspective view from

above of the push button of the circuit breaker of Figure 1.

[0025] Figure 17 shows a perspective view of the supporting fulcrum, of the mobile contact holder support 5 and of the fixed contact holder support.

[0026] Figure 18 shows a perspective view of the assembly of Figure 17 wherein it is also shown an elastic element, operatively coupled to the mobile contact holder support.

[0027] Figure 19 shows a perspective view of the assembly 10 of Figure 17 wherein a rocking control member is also shown.

[0028] Figure 20 shows a further perspective view of the assembly of Figure 19.

[0029] Figure 21 shows a perspective view or the rocking 15 control member of Figure 19.

DETAILED DESCRIPTION

[0030] With reference to the enclosed figures, it will be now described a particular non-limiting embodiment of a push button operated circuit breaker 10 with rocking 20 control member. By push button operated circuit breaker it is intended a circuit breaker operated manually through a push button in order to determine one, or at least one, electrical switching. Preferably, as in the illustrated example, the push button operated circuit

breaker 10 is of modular type, that is destined to be mounted on a supporting frame for the wall installation beside other modular circuit breakers of the same type or in general other electrical modular appliances, as for 5 example sockets. The circuit breaker 10 can be operated manually and can be used for example for controlling the electric power and/or the lighting in a residential or commercial building.

[0031] In the present description, by the term circuit 10 breaker it is meant both a device for opening and closing a single electrical contact and a device for opening an electrical contact with the contemporary closing of another electrical contact and vice versa (diverter).

[0032] The push button operated switch 10 with rocking 15 control member that, for ease of explanation, will be called in the present description also "circuit breaker" or "push button circuit breaker", includes a supporting structure 20 made of electrically insulating material, e.g. plastic, preferably having, but not restrictively, 20 approximatively the parallelepiped shape. The supporting structure 20, hereinafter called case, includes a bottom wall 21 and four lateral walls 20a, 20b, 20c, 20d joined to the bottom wall 21. The case 20 includes an open side 21' opposite to the bottom wall 21. The lateral walls 25 20a, 20b, 20c, 20d and the bottom wall 21 define a

recessed compartment adapted for housing the electromechanical components of the circuit breaker 10 and at least two electrical connection terminals C1, C2, C3. In the example shown in the Figures the recessed 5 compartment of the case 20 houses, without any limitation, three electrical connecting terminals C1, C2, C3.

[0033] Preferably, the bottom wall 21 is integrated in the case 20, however in an alternative embodiment the 10 bottom wall 21 may be a piece separated from the lateral walls 20a, 20b, 20c, 20d of the case 20 and coupled to them.

[0034] The push button operated circuit breaker 10 includes a push button 30, being operated manually to 15 command an electrical switching of the circuit breaker 10, having a body provided with lateral walls 30a, 30b, 30c, 30d crossing the open side 21' of the case 20. The push button 10 is adapted to slide with respect to the case 20 along a sliding axis Z-Z and along a delimited 20 space between a forward position and a backward position. For the purposes of the present description, by "forward position" it is meant an end of stroke position in the approaching movement of the push button 30 to the case 20, while by "backward position" it is intended an end of 25 stroke position in the distancing movement of the push

button 30 from the case 20. It is therefore clear that the terms "forward" and "backward" refer to the position of the push button 30 with respect to the case 20.

5 [0035] The push button operated circuit breaker 10 includes a guiding system adapted to guide the sliding of the push button 30 with respect to the case 20 along the sliding axis Z-Z.

10 [0036] Preferably, the guiding system is a system of spatially distributed guides including first guide elements 22, 32 operatively interposed between the lateral walls 20a, 20b, 20c, 20d of the case 20 and the lateral walls 30a, 30b, 30c, 30d of the body of the push button 30.

15 [0037] Preferably, the system of spatially distributed guides also includes second guide elements 23, 24, 33, 34 spaced apart with respect to the first guide elements 22, 32 and placed with respect to the first guide elements 22, 32 at a lower distance from the bottom wall 21 of the case 20. Most precisely, friction surfaces cooperating 20 between them of the first guide elements 22, 32, have a distance from the bottom wall 21 of the case 20 higher than the distance with respect to the bottom wall 21 of the case 20 of friction surfaces cooperating between them of the second guide elements 23, 24, 33, 34.

25 [0038] According to one advantageous embodiment, the

first guide elements 22, 32 include a first plurality of appendices 22 protruding from the lateral walls 20a, 20b, 20c, 20d of the case 20 towards the lateral walls 30a, 30b, 30c, 30d of the push button 30 and a second 5 plurality of appendices 32 protruding from the lateral walls of the push button 30 towards the lateral walls 20a, 20b, 20c, 20d of the case 20 and each being adapted to contact a respective appendix 22 of the first plurality of appendix 22 in order to slide thereon when 10 the push button 30 slides with respect to the case 20.

[0039] In the non-limiting exemplary embodiment shown in the Figures four appendices 22 protruding from the lateral walls 20a, 20b, 20c, 20d of the case 20 are provided as well as and four corresponding appendices 32 15 protruding from the lateral walls 30a, 30b, 30c, 30d of the push button 30.

[0040] According to one advantageous embodiment, the first plurality of appendices 22 and the second plurality of appendices 32 allow the lateral walls 30a, 30b, 30c, 20 30d of the push button 30 to be spaced from the lateral walls 20a, 20b, 20c, 20d of the case 20 when the push button 30 slides with respect to the case 20. Thereby, in fact, the push button operated circuit breaker 10 is less vulnerable to an undesired dust or sand intrusion within 25 the lateral walls 20a, 20b, 20c, 20d of the case 20 and

lateral walls 30a, 30b, 30c, 30d of the push button 30 that would otherwise cause a jamming in a circuit breaker wherein, on the contrary, due to a wide overlapping between the lateral walls of the push button 30 and those 5 of the case 20, there are wider friction surfaces.

[0041] According to one preferred embodiment, the aforesaid protruding appendices 22, 32 are linear appendices, which in the shown example extend linearly along axis that are parallel between them and parallel to 10 the sliding axis Z-Z.

[0042] According to one preferred embodiment, the lateral walls of button 30 are parallel in twos and define edges 32', each of them being arranged by a pair of adjacent lateral walls 30a, 30b, 30c, 30d of button 30. Each 15 appendix 32 of the second plurality of appendices is arranged on a corresponding edge 32'. Preferably, the edges 32' are bevelled.

[0043] According to one advantageous embodiment, the second guide elements 23, 24, 33, 34 are decentred with 20 respect to the first guide elements 22, 32. In other words, the second guide elements 23, 24, 33, 34 are closer to some of the first guide elements 22, 32 and further from other first guide elements 22, 32.

[0044] Preferably, with reference to Figures 4, 6 and 7 25 the second guide elements 23, 24, 33, 34 include a guide

seat 23 and a guide pin 33 having an end portion 34 slidable in the guide seat 23. In the non-limiting exemplary embodiment shown in the Figures, the guide pin 33 extends from the body of the push button 30 towards 5 the bottom wall 21 of the case 20 while the guide seat 23 is fixed to the bottom wall 21 of the case 20. Preferably, the guide pin 33 is integrated in the push button 30 and protrudes from the body of the push button 30 towards the bottom wall 21 of the case 20. Preferably, 10 the body of the push button 30 and the guide pin 33 form a single piece.

[0045] According to one advantageous embodiment, the aforesaid end portion 34 of the guide pin 33 has a cross-shaped cross-section. By cross-shaped cross-section, it 15 is intended a section on a plane that is perpendicular to the sliding axis Z-Z. In the particular embodiment shown in the Figures, the aforesaid cross-shaped cross-section includes a circular central part from which four arms originate forming a Greek cross.

20 [0046] According to one advantageous embodiment, the guide pin 33 does not interfere with the lateral walls 20a, 20b, 20c, 20d of the case 20 during the sliding movements of the push button 30 with respect to the case 20. In other words, the guide pin 33 is spaced apart from 25 the lateral walls 20a, 20b, 20c, 20d of the case 20 so as

to avoid having friction surfaces among the lateral walls of the case 20 and the guide pin 33 itself.

[0047] With reference to Figures 4 and 7, according to one embodiment the guide seat 23 includes four lateral 5 walls 24 parallel in twos. Preferably, the lateral walls 24 of the guide seat 23 are separated from one another and joined to the bottom wall 21 of the case 20. In one alternative embodiment the guide seat 33 may be a continuous collar, having a quadrangular or circular 10 section. In the particular example shown, the lateral walls 24 are integrated in the bottom walls 21 of the case 20, protruding from it towards the push button 30.

[0048] With reference to Figure 8 the push button operated circuit breaker 10 includes at least one elastic 15 element 40 adapted to exert a pushing force on the push button 30 in order to bring back or keep the push button 30 in the backward position in absence of external forces. In the particular embodiment shown in Figure 8 the circuit breaker 10 includes two elastic elements 40 20 having the form of two coil springs 40. In particular, in the shown example, the circuit breaker 10 also includes a diaphragm 41 housed inside the case 20 and the elastic elements 40 are operatively inserted between the diaphragm 41 and the body of the push button 30, each 25 having for example an end portion inserted in a

correspondent recessed seat 39 provided in the body of the push button 30 (Figure 6). Also in the diaphragm 41 recessed seats having the same function may be provided.

[0049] With reference to Figures 8-10, according to one 5 embodiment, in order to stop the push button 30 in the backward position, the push button operated circuit breaker 10 includes a first stopping system including contact surfaces 251, 351 of the lateral walls of the case 20 and of the lateral walls of the push button 30 10 respectively, which are abutting to each other when the push button 30 is in the backward position. In one particularly advantageous embodiment, the first stopping system includes a button alignment system including alignment elements 250, 350 engaging with each other 15 starting from a given point on during the sliding movement of the push button 30 from the forward position towards the backward position before reaching the backward position. Such alignment elements 250, 350 allow to progressively align the push button 30 with respect to 20 a reference plane R_P (Figure 11) that is perpendicular to the sliding axis Z-Z.

[0050] According to one advantageous embodiment, the aforesaid alignment elements 250, 350 include at least a variable cross-section guide 250, and a corresponding 25 variable cross-section slider 350 adapted to be inserted

inside the variable cross-section guide 250, starting from a given point on during the motion of the push button 30 before reaching the backward position and up until reaching it. Preferably the variable cross-section 5 guide 250 is a tapered guide, having a decreasing cross-section in the direction towards the reference plane R_P). In this case, for example, the variable cross-section slider 350 is wedge-shaped.

[0051] According to one advantageous embodiment, in order 10 to further increase the precision of the alignment of the push button 30 with respect to the reference plane R_P and to guarantee a better coupling between the push button 30 and the case 20, the contact surfaces 251 and 351 are surfaces that, in the backward position of the 15 push button 30, lie on a plane I_P inclined with respect to the reference plane R_P.

[0052] According to one particularly advantageous embodiment, the circuit breaker 10 includes complementary snap-fit coupling elements 25, 35 provided on the lateral 20 walls of the case 20 and on the lateral walls of the body of the push button 30. The above said snap-fit coupling elements 25 are shaped in order to ease a forced insertion of the body of the push button 30 through the open side 21' of the case 20 in the assembling phase of 25 the push button-case assembly and, once they pass a

snapping position, to make interlocking snap fit coupling between the push button 30 and the case 20, based on which the push button 30 is slidingly constrained to the case 20.

5 [0053] In the particular example represented in the Figures, without limitation, said snap-fit coupling elements 25, 35 include four snap-fit coupling teeth 25 on the lateral walls of the case 20 and four complementary snap-fit coupling teeth 35 arranged on the 10 lateral walls of the body of the push button 30. Preferably the snap-fit coupling teeth 25, 35 are arranged at the corners of a rectangular or square lying on a plane that is perpendicular to the sliding axis Z-Z.

15 [0054] According to one particularly advantageous embodiment, the above described snap-fit coupling elements 25, 35 carry the above described alignment elements 250, 350 and preferably the above described contact surfaces 251, 351 too.

20 [0055] According to one preferred embodiment, in order to stop the push button 20 in the forward position, the push button operated circuit breaker 10 includes a second stopping system including contact elements 26, 36 respectively provided on the lateral walls of the case 20 and on the lateral walls of the body of the push button 25 30. In the particular example shown, the aforesaid

contact elements 26, 36 include two small blocks 36 protruding from opposite walls 30b, 30d of the push button body 30 and stopping seats 26 provided on two opposite lateral walls 20b, 20d of the case 20.

5 [0056] According to one embodiment, the push button operated switch 10 includes a supporting fulcrum 50 housed inside the case 20. As known, in a circuit breaker a supporting fulcrum 50 serves as a supporting means for a mobile electrically conductive switching member, being
10 in particular rotatable, carrying at least a mobile electrical contact element. The aforesaid mobile electrically conductive switching member will be called in the present description rotatable contact holder support. The supporting fulcrum 50 is for example made of
15 metal foil folded and sheared off.

[0057] According to one advantageous embodiment, in order to guarantee a stable fixing of the supporting fulcrum 50 to the case 20, the case 20 includes a housing seat 27 of the supporting fulcrum 50 and the push button operated
20 circuit breaker 10 includes a snap-fit coupling system adapted to fix the supporting fulcrum 50 to the case 20 in the housing seat 27. Preferably, the housing seat 27 is arranged inside the case 20 on the bottom wall 21 and the snap-fit coupling system includes at least a coupling
25 elastic tooth 28 adapted to hook the supporting fulcrum

50 to the bottom wall 21 of the case 20. Preferably the aforesaid coupling elastic tooth 28 is integrated in the bottom wall 21 of the case 20 and forms a single piece with the latter. In the example shown in the Figures, the
5 snap-fit coupling system includes a plurality of coupling elastic teeth 28, in particular three coupling elastic teeth 28.

[0058] According to one advantageous embodiment allowing to simplify the manufacturing of the case 20, beneath the
10 coupling elastic tooth 28, the bottom wall 21 of the case 20 has a pass-through opening 28'. Thereby, it is usefully avoided having to mould in the bottom wall 21 of the case 20 undercut opposite surfaces.

[0059] According to one preferred embodiment, the
15 coupling elastic tooth 28 has a free end portion and an opposite end fastened to the bottom wall 21 of the case 20 and the free end portion is such that it engages with a peripheral portion of the supporting fulcrum 50.

[0060] According to one advantageous embodiment, at least
20 two snap-fit coupling teeth 28 are provided, arranged at opposite sides with respect to the supporting fulcrum 50.

[0061] According to one embodiment, the housing seat 27 of the supporting fulcrum 50 is a recessed seat implemented in the bottom wall 21 of the case.
25 Preferably, the fulcrum 50 includes a support and contact

portion 51 that is shaped so as to form a groove, for example having a V-shaped cross section, housed inside the recessed housing seat 27. Preferably, the support fulcrum 50 also includes a connecting portion 52, being 5 part of a connecting terminal 50 of the circuit breaker 10. The connecting terminal C1 includes a screw 54 and a clamping plate 55, and the screw 54 crosses the connecting portion 53 of the supporting fulcrum 50 to engage with the clamping plate 55. According to one 10 advantageous embodiment, between the support and contact portion 51 and the connecting portion 53, the supporting fulcrum 50 includes an intermediate portion 52 forming a connection inclined plane between the support and contact portion 51 and the connecting portion 53.

15 [0062] According to one particularly advantageous embodiment, the circuit breaker 10 also includes an anchoring system 59, 29 of the supporting fulcrum 50 to the case 20, in particular to the bottom wall 21 of the case 20. For example the anchoring system 59, 29 includes 20 a folded little wing 59 integrated in the supporting fulcrum 50 and an anchoring seat 29 (visible in Figure 4) arranged inside the bottom wall 21 of the case 20 housing the folded little wing 59. This allows to stabilise the supporting fulcrum 50 position also with respect to the 25 external stresses that affect for example the supporting

fulcrum 50 during the wiring operations of the circuit breaker 10, for example caused by the clamping of the connecting terminal C1.

5 [0063] Apart from the specific example shown in the drawings, more general or more specific embodiments have been so far described wherein the circuit breaker 10 is a generic push button operated circuit breaker.

10 [0064] Hereinafter some embodiments will be described wherein the circuit breaker 10 is a push button operated circuit breaker with a rocking mechanism. An embodiment of a push button operated circuit breaker with rocking mechanism is for example disclosed in the European patent EP1866944. Apart from the peculiar embodiment disclosed in such patent, it must be noted that by button operated 15 circuit breaker with rocking mechanism it is to be intended in general a circuit breaker operated by a sliding button including a rocking element that controls the switching, hereinafter called, for ease of explanation, rocking control member.

20 [0065] With reference to Figures 3, 5, 6, according to one advantageous embodiment the push button 30 includes a pressure transmitting member 60 rotatably fastened to the body of the push button 30. The pressure transmitting member 60 is adapted to rotate into two opposed 25 directions starting from a resting position (or central

position) and the push button 30 includes at least an elastic element 61 adapted to bring the pressure transmitting member 60 back to the angular resting position after one rotation. Referring to Figures 6 and 5 15, it must be noted that the pressure transmitting member 60 is adapted to rotate around the rotation axis A1-A1 (that will be called third rotation axis).

[0066] In order to allow a user to manually operate the push button 10 perceiving a very limited resistance, the 10 aforesaid elastic element is, or includes, a wire spring 61 and preferably a rectilinear wire spring. The aforesaid wire spring 61 is, for example, a wire spring made of spring steel. It has been observed that a wire spring 61 with reduced section too, for example with a 15 diameter included between 0,25 mm and 0,75 mm and for example equal to 0,5 mm, is able to bring the pressure transmitting member 60 back to the angular resting position and is able to resist to the stresses generated when the push button 30 is manually operated.

20 [0067] Preferably, the aforesaid wire spring 61 has two opposite end portions 62 constrained to the push button 30 and a central portion 63 adapted to exert an elastic strength on the pressure transmitting member 60. Preferably, referring to Figure 15, the pressure 25 transmitting member 60 includes a central portion 600 and

pressure transmitting member 60, thereby the wire spring 61 is arranged on one side of the pass-through opening 360 together with at least a part of the central portion 600 of the pressure transmitting member 60, while the remaining part of the pressure transmitting member 60 is arranged on the other side of said pass-through opening 360.

[0069] With reference to Figure 15, according to one further advantageous embodiment, the pressure transmitting member 60 includes two opposite hinge pins 610 that originate from the central portion 600 of the aforesaid member. For example, the two hinge pins 610 are cylindrical pins. Such hinge pins 610 are oriented along the rotation axis A1-A1 of the pressure transmitting member 60. According to one advantageous embodiment, in order to simplify the assembly of the push button 30, the latter includes two semicircular recesses (visible in Figure 6), or generally having the shape of an arc of the circle, aligned along the rotation axis of the pressure transmitting member 60 each of which is adapted to partially receive a respective pin 610. In such case, the wire spring 61, apart from serving as elastic return to make the pressure transmitting member 60 return into its resting position, also serves favourably as fixing element of the member 60 to the push button 30.

[0070] According to one advantageous embodiment, referring

circle, aligned along the rotation axis of the pressure transmitting member 60 each of which is adapted to partially receive a respective pin 610. In such case, the wire spring 61, apart from serving as elastic return to 5 make the pressure transmitting member 60 return into its resting position, also serves favourably as fixing element of the member 60 to the push button 30.

[0070] According to one advantageous embodiment, referring to Figure 16, the push button 30 includes a 10 fixing seat 361 of the wire spring 61 made in the thickness of the bottom wall 31 of the push button 30 and that in the embodiment is placed on top of the pass through opening 360 of the push button 30. Preferably, such fixing seat 361 includes two grooves 362 aligned to 15 each other along the direction of prevalent longitudinal extension of the wire spring 61 and are crossed by the end portions 62 of the wire spring 61. Preferably, the end portions 62 of the wire spring 61 protrude beyond such grooves 362 from opposite sides with respect to the 20 central portion 63 of the wire spring 61. Conveniently, the fixing seat 361 of the wire spring 61 includes stopping elements 365 adapted to limit or prevent an undesired translation of the wire spring 31 with respect 25 to the push button 30. Such translation may in fact determine and undesired detachment of the wire spring 61

from the push button 30 and, thus, in the embodiment also of the pressure transmitting member 60.

[0071] With reference to Figure 7, the aforesaid pressure transmitting member 60 contacts, from a certain 5 point on during the sliding of the push button 30 from the backward position to the forward position, a commutation rocking control member 70, e.g. a bistable member, included in the push button operated circuit breaker 10. By rocking control member it is meant a 10 rocking control member adapted to control the switching. After such contact, the pressure transmitting member 60 starts rotating with respect to the resting position, and during a further advancement of the push button 30 it determines a rotation of the rocking control member 70 15 starting from a first operative position until it reaches a second operative position. At this point, if the pressure of the push button 30 is released, it will be able to return back to the backward position and the pressure transmitting member 60 can return back to the 20 resting position as a result of the elastic return force of wire spring 61, whilst the control rocking member 70 will be able to remain in the second operative position, if it is a stable position, or, in the opposite case, return back to the first operative position (e.g. as a 25 result of a return force applied by an elastic element).

In case the control rocking member 70 returns in the first operative position, a further pressure of the push button 30 will determine a sequence of movements as the above described one. In case, on the contrary, the 5 rocking control member 70 remains in the second operative position, at the moment of a further pressure of the push button 30 through a sequence of movements similar to the above described one, it will be able to return in the first operative position and remain there despite the 10 push button 30 is released and until a later pressure of the push button 30.

[0072] With reference to Figures 17-21, the push button operated circuit breaker (10) includes at least a fixed electrical contact element 92, 92' (hereinafter also 15 called fixed contact element) and at least a mobile element of mobile contact 82, 82' (hereinafter also called mobile contact element) and the rocking control member 70, by moving as a result of the pressure transmitted by the pressure transmitting member 60, 20 determines a rotation of the rotatable contact holder support 81 around a rotation axis A3-A3 (hereinafter also called a first rotation axis) that in its turn, rotates the mobile electrical contact element 82 between a first and a second operative position, being angularly spaced 25 from one another. In the non-limitative embodiment shown

in Figures 17-21, the switch 10 includes two opposite mobile electrical elements 82, 82' and two fixed electrical contact elements 92, 92', being spaced apart and each other fronted. In this case the circuit breaker 5 10 is thus a two-way diverter, whereby in one of the aforesaid operative positions the mobile contact element 82 is in contact with a fixed contact element 92 and the mobile contact element 82' is separated from the other fixed contact element 92' while in the other operative 10 position the mobile contact element 82 is separated from the fixed contact element 92 and the mobile contact element 82' is in contact with the other fixed contact element 92'. However, it is to be noted that the teachings of the present description can be easily 15 applied from an expert in the field even to the case of a push button operated circuit breaker 10 having a single fixed electrical contact element and a single mobile electrical contact element. Thus, it is possible to generalise by stating that the mobile electrical contact 20 element is 82, 82' rotates around a rotation axis A3-A3 among two operative positions angularly spaced in order to interrupt or deviate an electrical circuit. From now on, reference will be made, without limitation, to the case wherein the circuit breaker 10 includes two mobile 25 electrical contact elements 82, 82' and two fixed electrical contact elements 92, 92'. In such a case the

circuit breaker 10 includes two fixed contact holder supports 91, 91' to which the fixed contact elements 92, 92' are respectively fixed, e.g. welded. The fixed contact holder supports 91, 91' are made of electrically 5 conductive material, e.g. copper, and each one includes a connecting portion 93, 93'. Each connecting portion 93, 93' is for example part of a corresponding electrical connecting terminal C2, C3 of the circuit breaker 10. Each connecting clamp C2, C3 includes a screw 94, 94' and 10 a clamping plate 95, 95' and each screw 94, 94' crosses the respective connecting portion 93, 93' for engaging with an associated clamping plate 95, 95'.

[0073] The mobile electrical contact elements 82, 82' are for example two opposite electrically conductive pads, 15 e.g. made of sintered silver, fixed, e.g. welded, at the opposite sides of an end portion of a mobile contact holder support 81, also made of electrically conductive material, e.g. copper. It is thus clear that in this embodiment the mobile electrical contact elements 82, 82' 20 are electrically connected between them. The opposite end portion of the mobile contact support 81 lies on the supporting fulcrum 50 and in particular on the portion and support and contact 51 of the supporting fulcrum 50. The mobile contact holder support 81 rotates around a 25 first rotation axis A3-A3, in the example defined by the

supporting fulcrum 50, in order to rotate the mobile electrical contact element 82, 82' between the first and the second operative portion and vice versa. For example, the mobile contact holder support 81 is an L-shaped plate

5 having a larger base 810 lying on the supporting fulcrum 50 and a more narrow arm 811 than the base 810 that protrudes from the base 810 and on whose end portion opposite to the base 810 the mobile electrical contact elements 82, 82' are fixed.

10 [0074] The rocking control member 70 includes a body 75, preferably made of electrically insulating material, e.g. plastic, rotatable with respect to the case 20 so as to rotate around a rotation axis A2-A2 (herein also called second rotation axis), parallel to a first rotation axis

15 A3-A3, in order to rotate the rotatable contact holder support 81. Preferably, the second rotation axis A2-A2 is parallel both to the third rotation axis A1-A1 and to the first rotation axis A3-A3. Preferably, the body 75 of the rocking control member 70 is rotatably hinged to the case

20 20.

[0075] According to an advantageous embodiment, in order to further reduce the axial encumbrance of the push button operated circuit breaker 10, the body 75 of the rocking control member 70 is shaped in such a way that

25 the rotatable contact holder support 81 in the rotation

around the first rotation axis A3-A3 can cross the second rotation axis A2-A, that is the rotation axis of the body 75 of the rocking control member 70.

[0076] Preferably, the body 75 of the rocking control member 70 includes a contact portion 72 having two shaped surfaces 701, 702 intended to be alternatively contacted and pushed by the pressure transmitting member 60, and in particular by the two appendices 601, 602. Preferably, the two shaped surfaces 701, 702 are two stepped surfaces.

10 [0077] According to one embodiment, the body 75 of the rocking control member 70 includes a bridge portion 71 bypassing an operative space 710 in which the rotatable contact holder support 81, or an end portion thereof, as for example an end portion of the arm 811 is free to

15 rotate. For example, the bridge portion 71 includes at least a bended bridge arm 711, 712, 713, preferably two coplanar bended bridge arms 711, 713 originating from two different points of the body 75 and joining in the same point. In the particular embodiment shown, the bridge

20 portion 71 includes three bended bridge arms 711, 712, 713 originating from three different points of the body 75 and joining in the same point to form a cage structure that defines the operative area 710 within which the rotatable contact holder support 81, or an end portion

25 thereof, as for example an end portion of the arm 811, is

free to rotate. According to one possible embodiment, the bridge portion 71 may include a continuous bridge wall provided with a recess or a pocket within which the rotatable contact holder support 81, or an end portion 5 thereof, is free to rotate.

[0078] According to one advantageous embodiment, as in the example shown in the Figures, the bridge portion 71 bypasses also a space occupied by the fixed contact holder support 91, 91', by the fixed electrical contact element 92, 92' and by the mobile electrical contact element 82, 82'. In such a way, the bridge portion 71 bypasses a space region of the circuit breaker 10 in which the joining and separation between the mobile electrical contact element 82, 82' and the fixed 15 electrical contact element 92, 92' occurs.

[0079] According to one embodiment, the rocking control member 70 includes two opposite coupling elements that allow the rotatably coupling of the control member 70 with two opposite lateral walls of the case 20. In the 20 particular example shown in the figures, the aforesaid coupling elements include two opposite cylindrical shaped pins 76 protruding from the body 75 along the rotation axis A2-A2 towards opposite directions. According to one advantageous embodiment, one of the aforesaid pins 76 25 protrudes from the contact portion 72 and the other one

of said pins protrudes from the bridge portion 71. For example, such pins 76 are inserted in corresponding pass through holes or recesses 276 arranged in two opposite lateral walls of the case 20.

5 [0080] According to one embodiment, the body 75 of the rocking control member 70 includes a portion 73 containing an internally hollow seat adapted to receive an elastic element, e.g. a coil spring 77, operatively inserted between the rocking control member 70 and the
10 mobile contact holder support 81. For example, the mobile contact holder support 81, and in particular its base 810, includes in fact a protruding appendix 87 inserted inside the coil spring 77.

[0081] According to further embodiments, in the body of
15 the rocking control member 70 further accessory elements can be provided, such as a wall 79 with a recess (not visible in the drawings because it points to the bottom wall 21 of the case 20) adapted to receive an end of an elastic element (as for example a coil spring) adapted to
20 make the rocking control member 70 a monostable member.

[0082] As clearly shown from the above description, the proposed button operated circuit breaker with rocking control member 10 allows to fully achieve the planned scopes in terms of overcoming the drawbacks of the
25 circuit breakers of the prior art. As a matter of fact,

experimental evidence has demonstrated that, thanks to the provision of an elastic element which is or includes a wire spring 61, if compared to the push button circuit breakers of the prior art, it is possible to 5 significantly reduce the resistance perceived when pushing the push button 30 starting from the moment when the pressure transmitting member 60 contacts the rocking control member 70. This contributes to produce a sensation of greater fluidity when pushing the push 10 button.

[0083] Subject to the principle of the invention, the embodiments and the implementation details shall be widely varied with respect to what has been said and shown for exemplary purposes but not limited to, without 15 detaching from the field of the invention as defined in the enclosed claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A push button operated circuit breaker with rocking control member including:
 - a case made of electrically insulating material, having a bottom wall, lateral walls being joined to the bottom wall and an open side opposite to the bottom wall;
 - a push button that can be operated to command an electrical switching of the switch and having a body provided with lateral walls crossing said open side, the push button being adapted to slide with respect to the case along a sliding axis, between a forward position and a backward position;
 - a rocking control member adapted to control an electrical switching;
 - a pressure transmitting member being rotatably constrained to the body of the push button and adapted to rotate with respect to a rest angular position around a rotation axis;
 - an elastic element adapted to bring back the pressure transmitting member in the rest angular position after its rotation;

wherein:

- the above-mentioned elastic element is, or includes, a wire spring;
- the body of the push button includes a pass-through opening, crossed by the pressure transmitting member, thereby the wire spring is arranged on one side of the pass-through opening together with at least one a part of a central portion of the pressure transmitting member, while the remaining part of the pressure transmitting member is arranged on the other side of said pass-through opening .

2. The push button operated circuit breaker according to claim 1, wherein the wire spring is a rectilinear wire spring.

3. The push button operated circuit breaker according to claim 1 or 2, wherein the wire spring has a diameter between 0.25 mm and 0.75 mm.

4. The push button operated circuit breaker according to any one of the previous claims, wherein the wire spring has two opposite end portions constrained to the body of the push button and a central portion adapted to exert an elastic force on the pressure transmitting member.

5. The push button operated circuit breaker according

to claim 4, wherein the pressure transmitting member includes two appendices originating from the central portion, wherein the central portion of the pressure transmitting member includes a channel (630) crossed by the central portion of the wire spring.

6. The push button operated circuit breaker according to any one of the previous claims, wherein the push button includes a fixing seat of the wire spring made in the thickness of the bottom wall of the push button and placed on top of the pass through opening of the push button.

7. The push button operated circuit breaker according to any one of the previous claims, wherein:

- the pressure transmitting member includes two opposite hinge pins directed along the rotation axis of the pressure transmitting member;
- the body of the push button includes two semicircular or circular arc shaped recesses, being aligned along the rotation axis each of them being adapted to partially receive a respective pin.

8. The push button operated circuit breaker according to claim 6, wherein the fixing seat of the wire spring includes two grooves being aligned to each other along the direction of prevalent longitudinal extension of the

wire spring and being crossed by the end portions of the wire spring, wherein the end portions of the wire spring protrude beyond those grooves on opposite sides with respect to the central portion of the wire spring.

9. The push button operated circuit breaker according to claim 8, wherein the fixing seat of the wire spring includes stopping elements adapted to limit or prevent the translation of the wire spring with respect to the push button.

10. The push button operated circuit breaker according to any one of the previous claims, wherein the wire spring is made of spring steel.

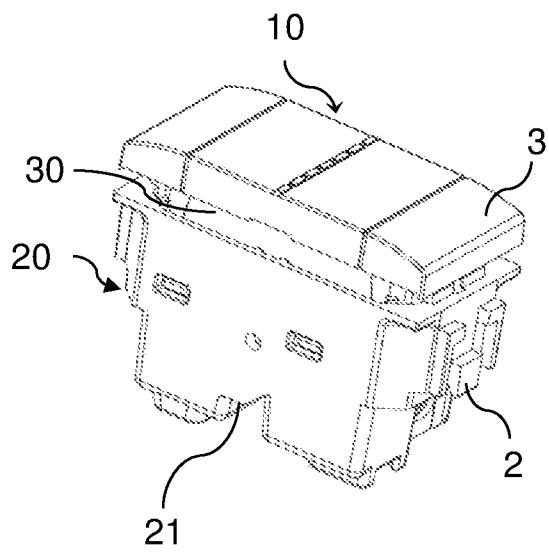


FIG. 1

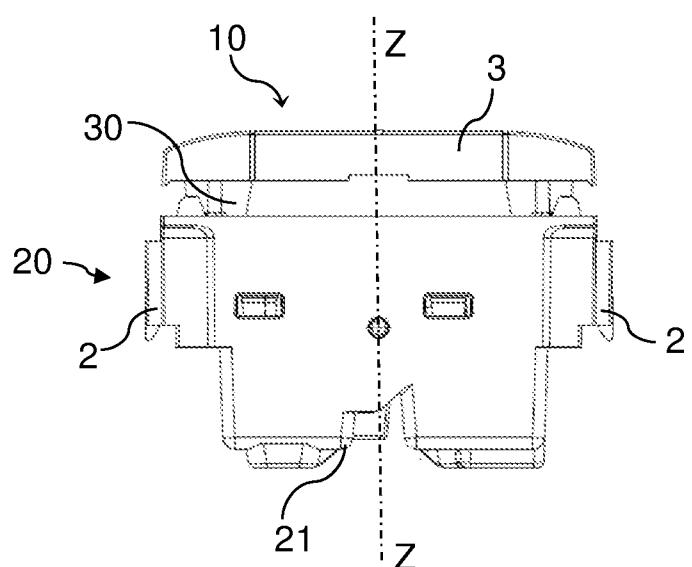


FIG. 2

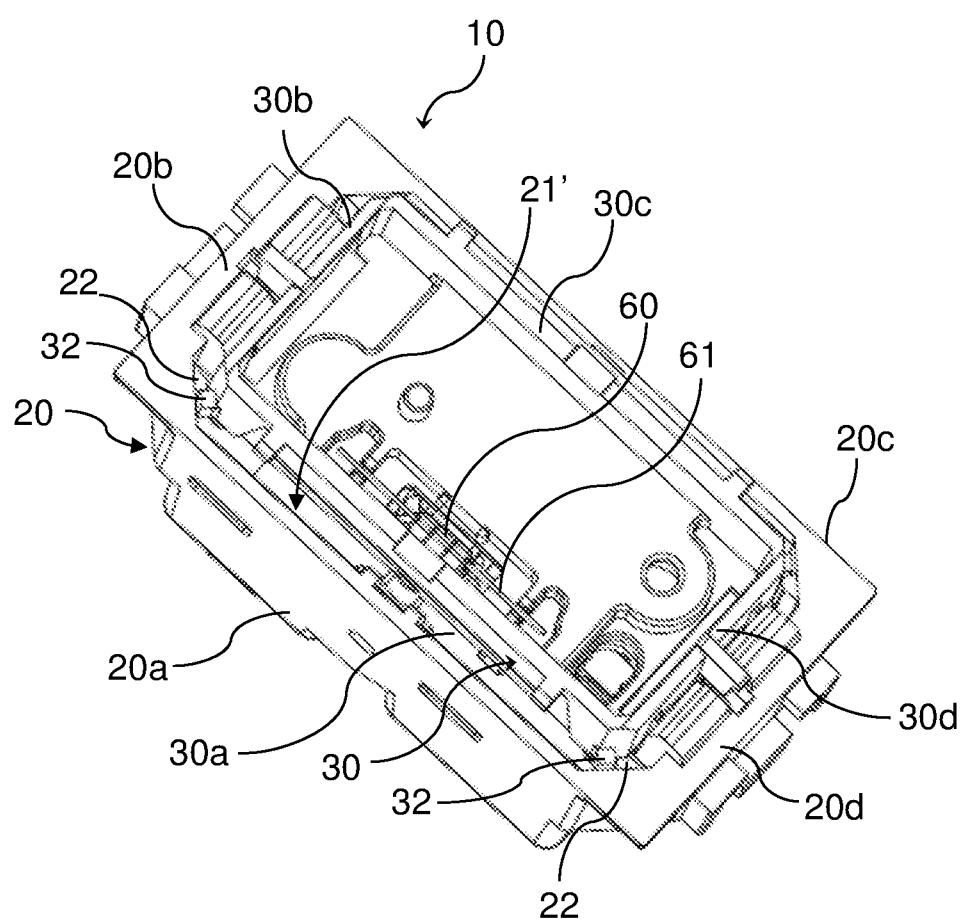


FIG. 3

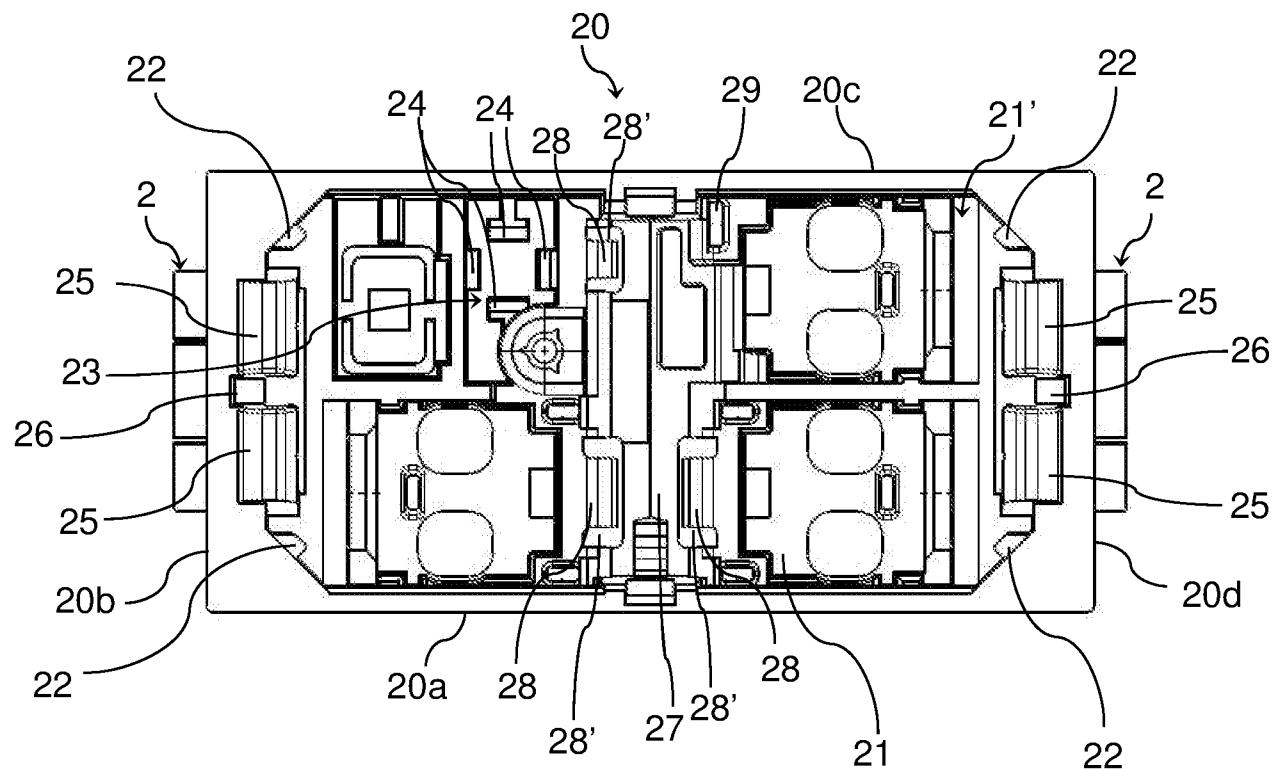


FIG. 4

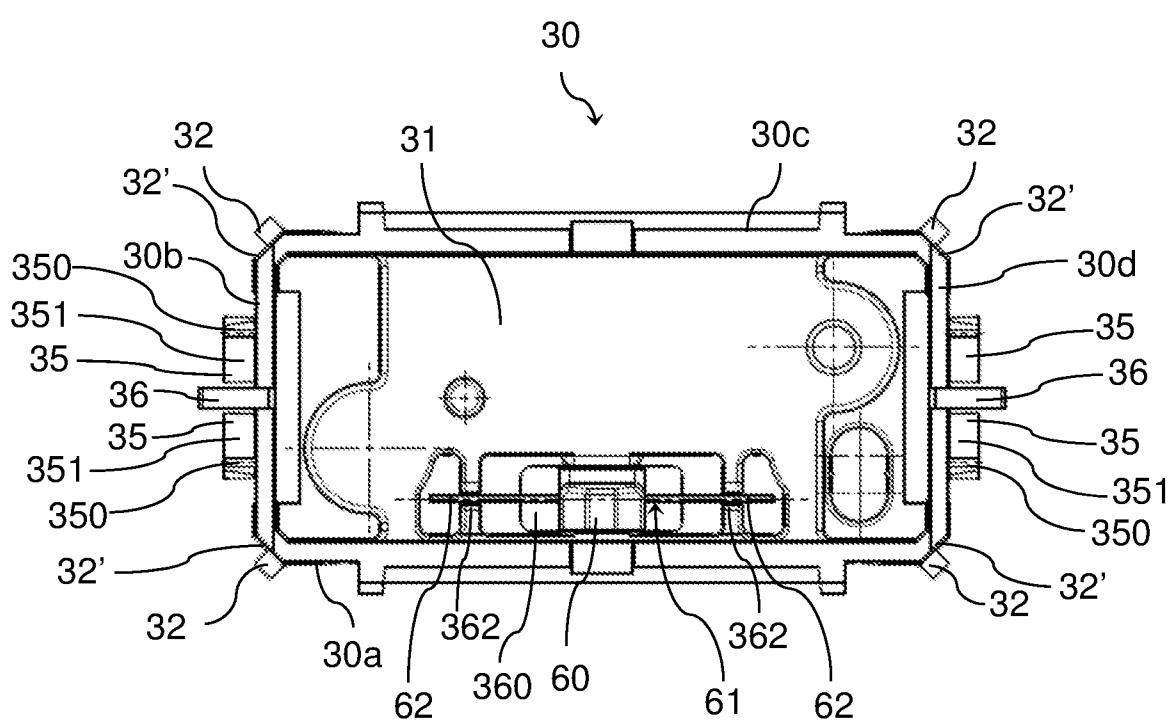


FIG. 5

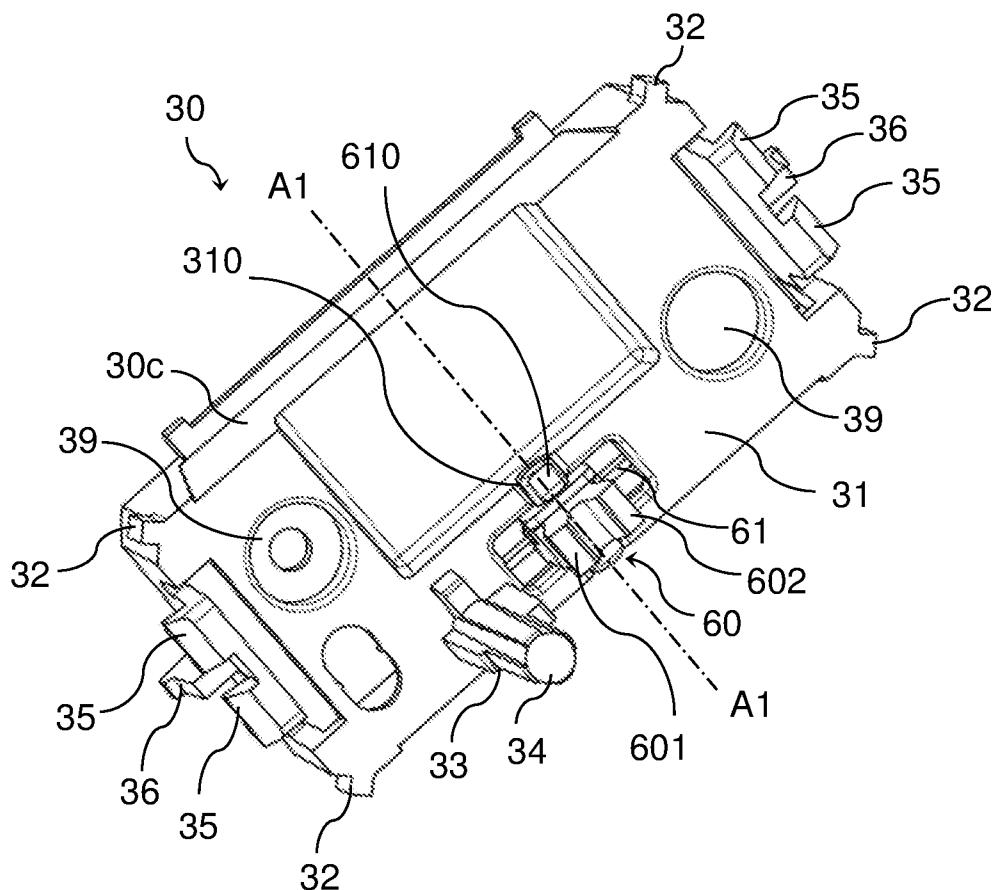


FIG. 6

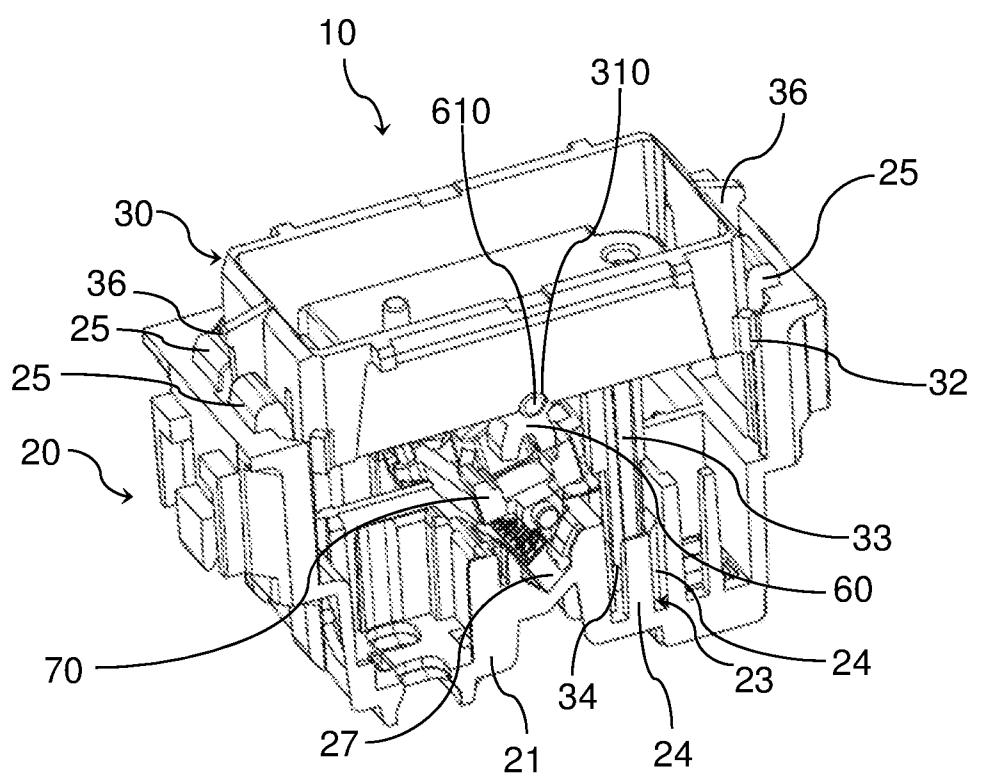


FIG.7

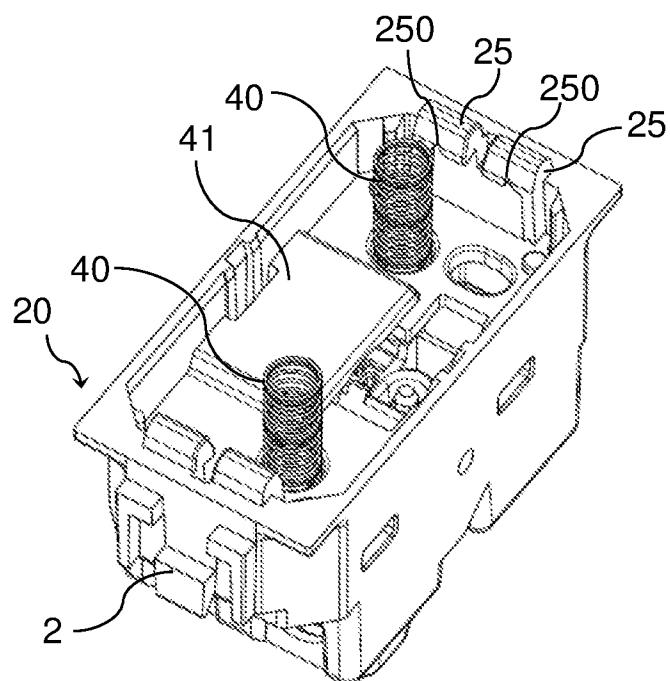


FIG. 8

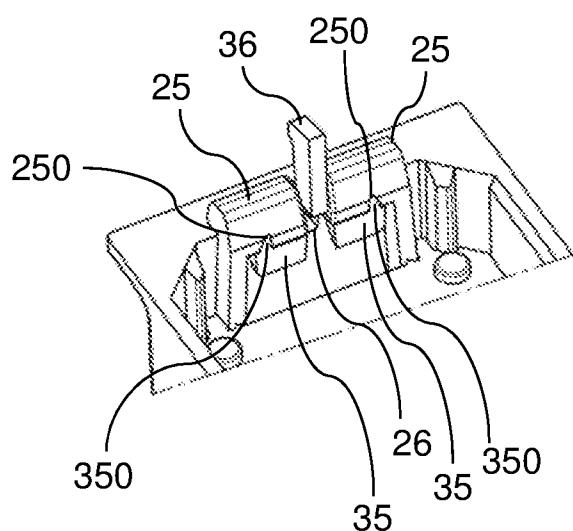


FIG. 9

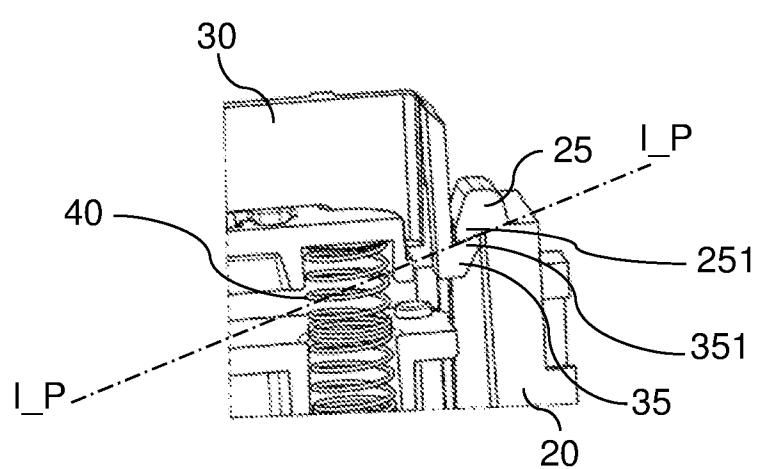


FIG. 10

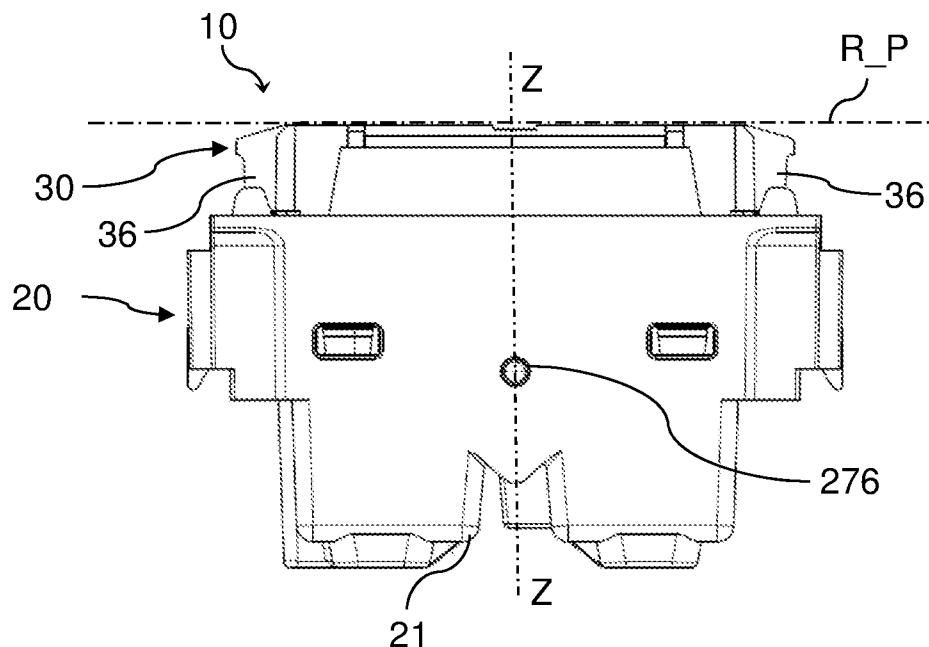


FIG. 11

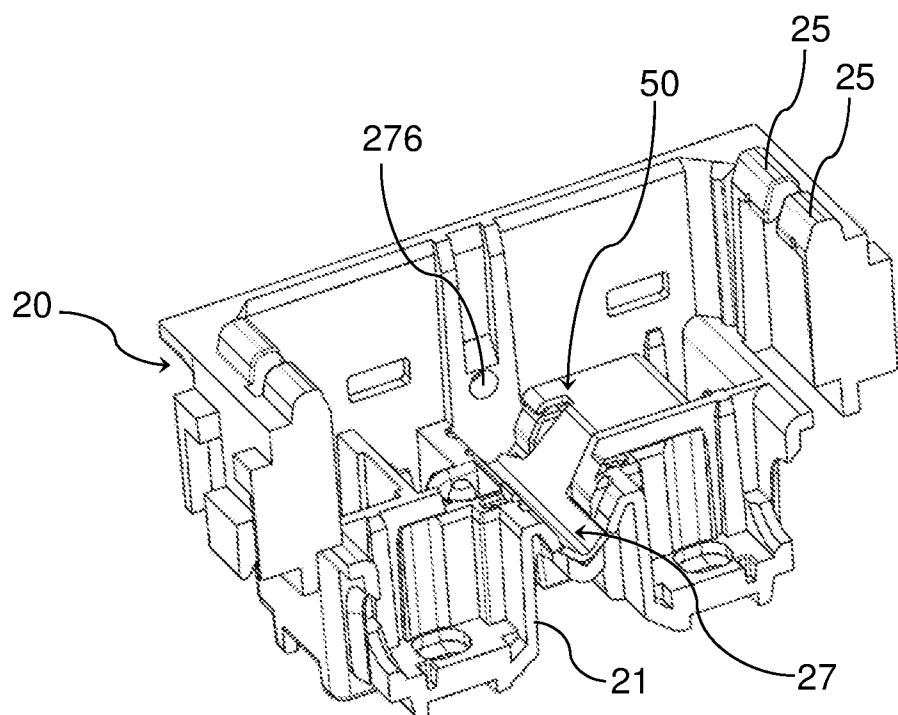


FIG. 12

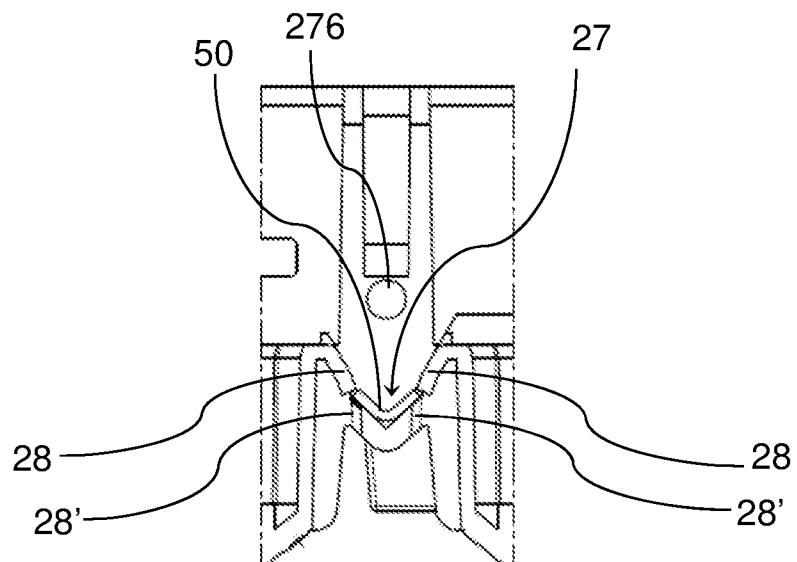


FIG. 13

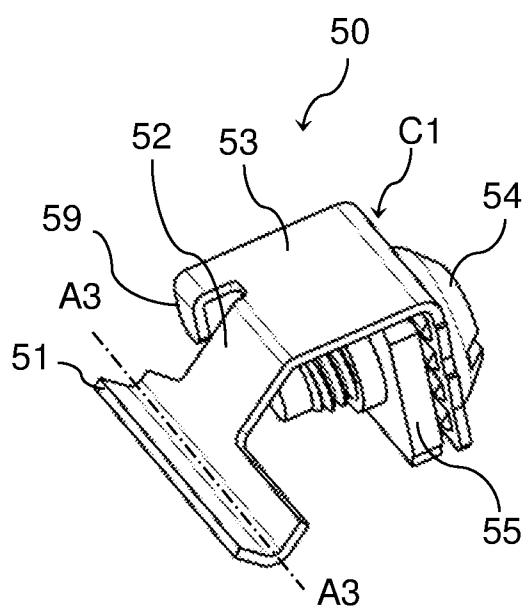


FIG. 14

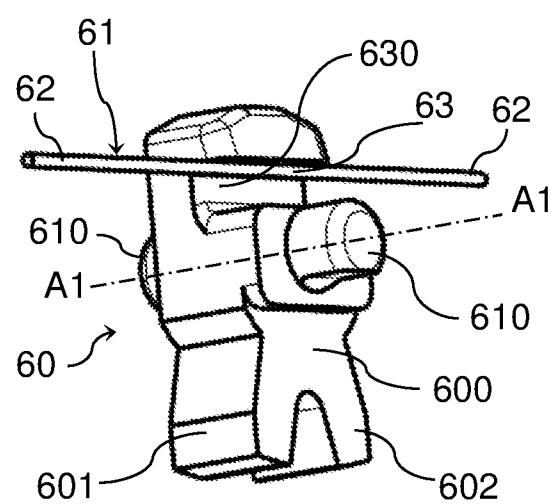
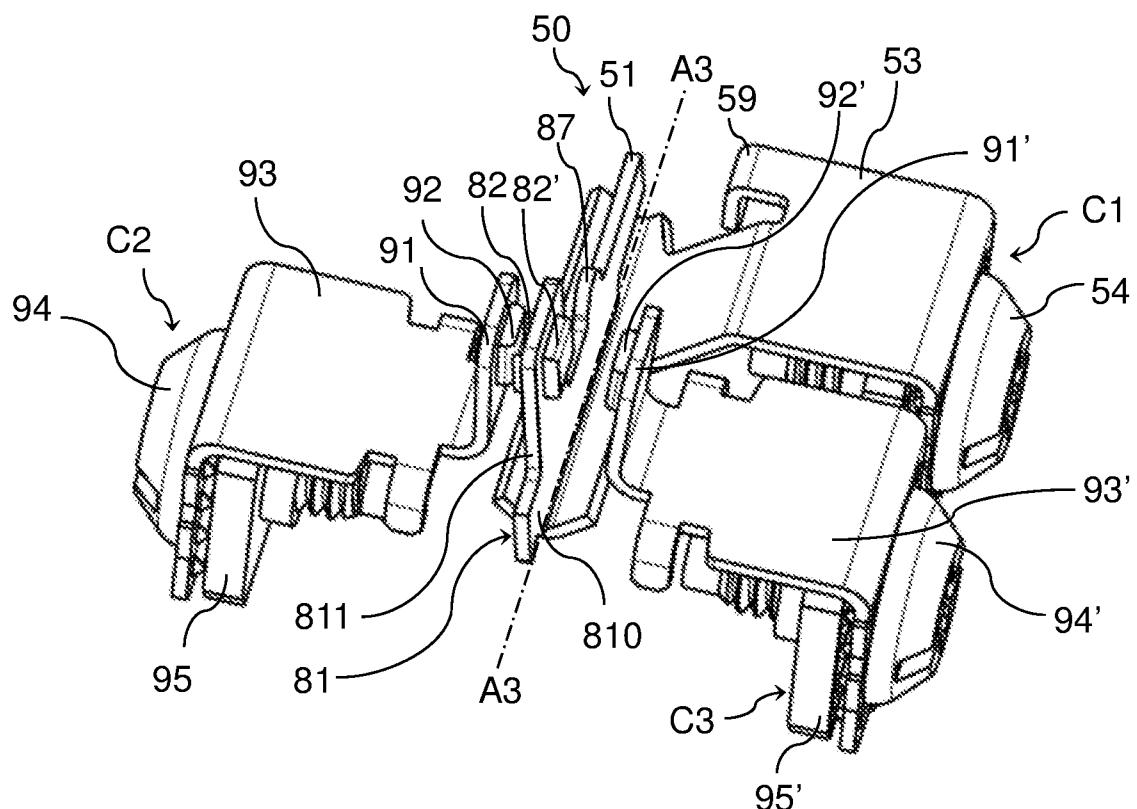
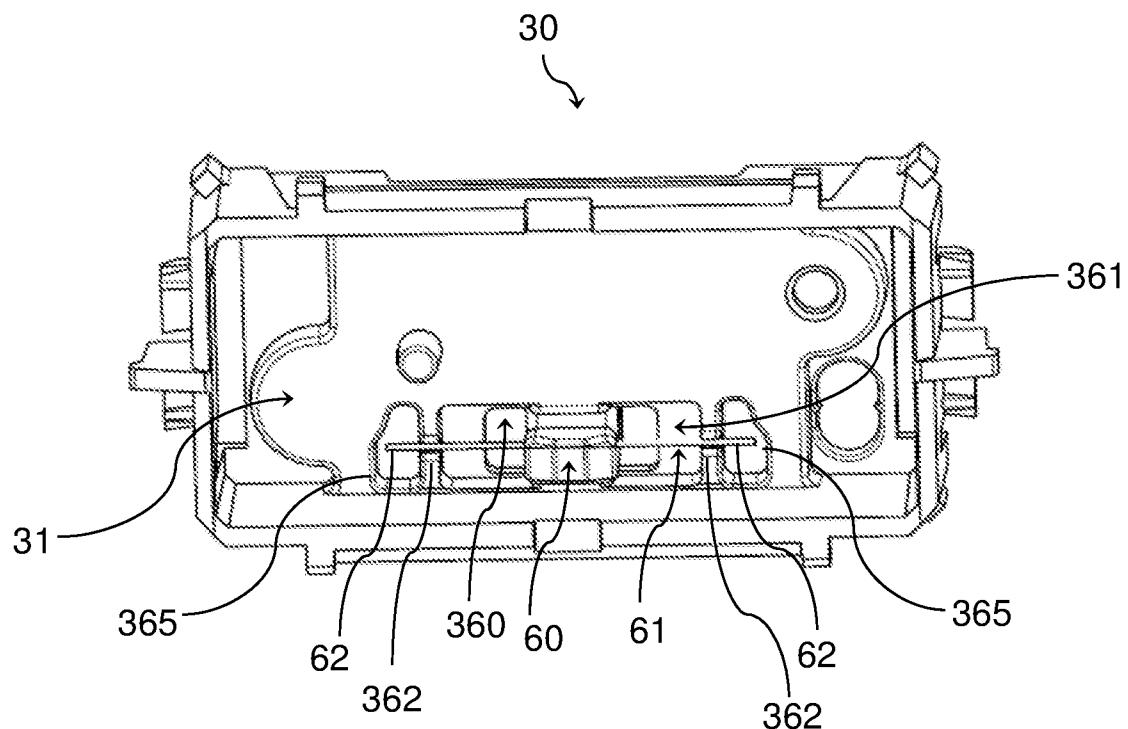


FIG. 15



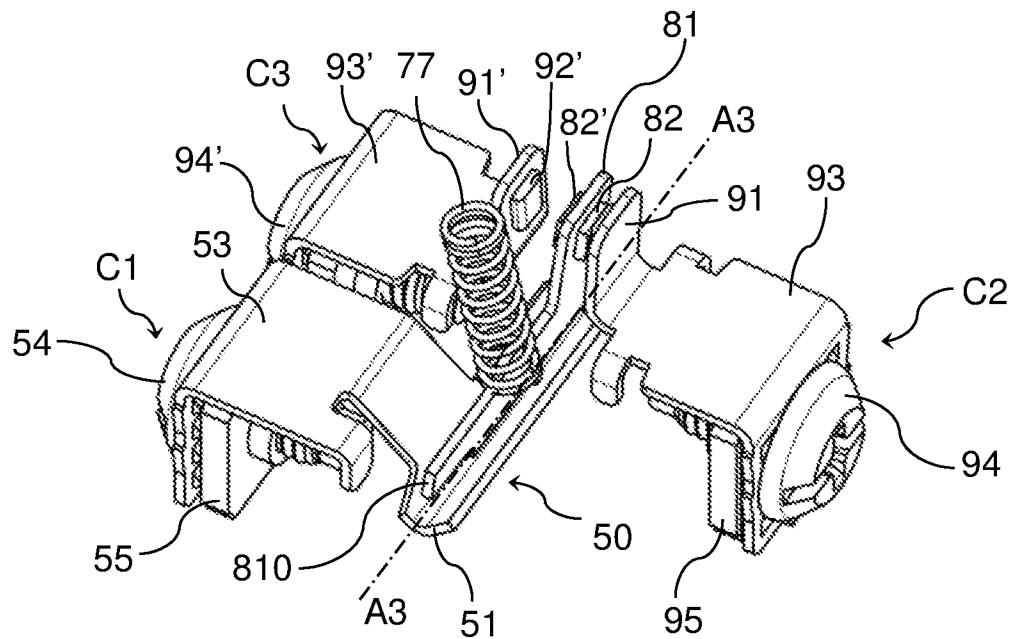


FIG. 18

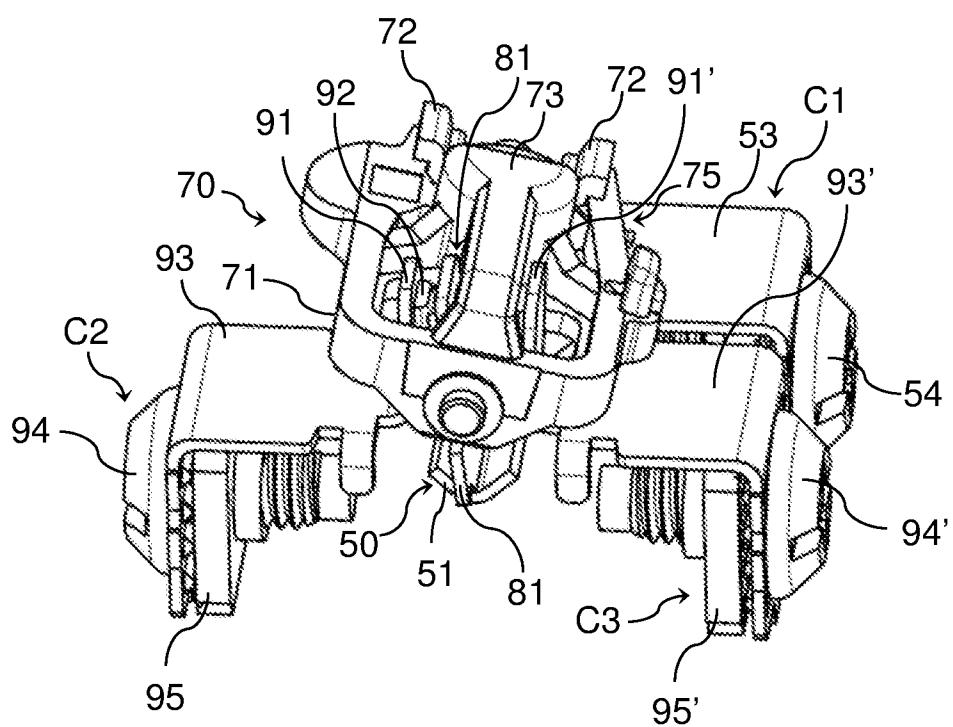


FIG. 19

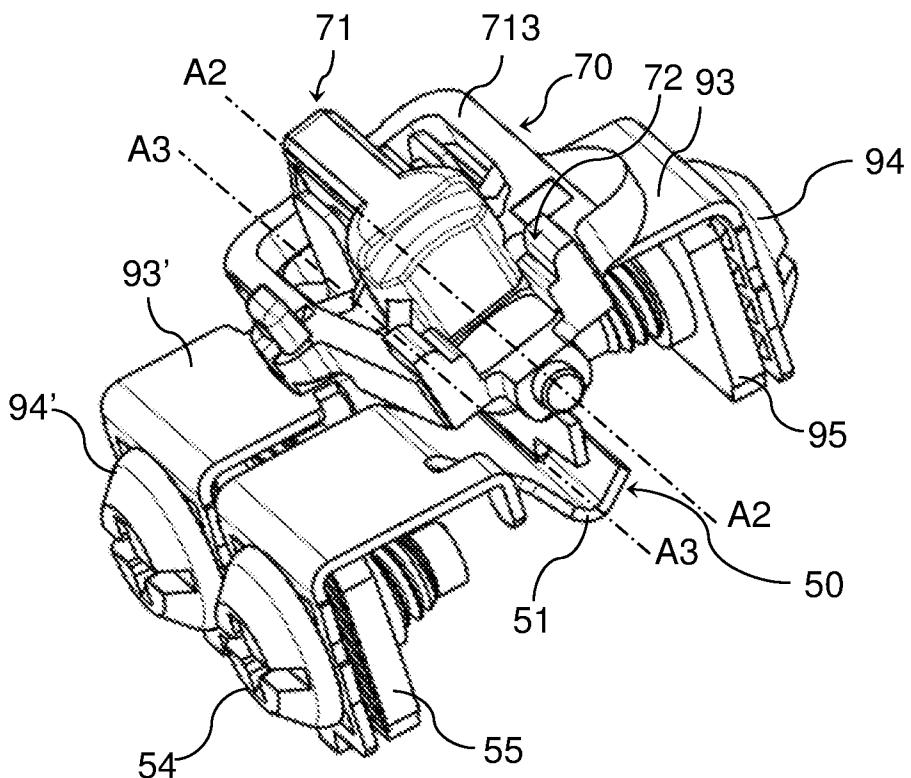


FIG. 20

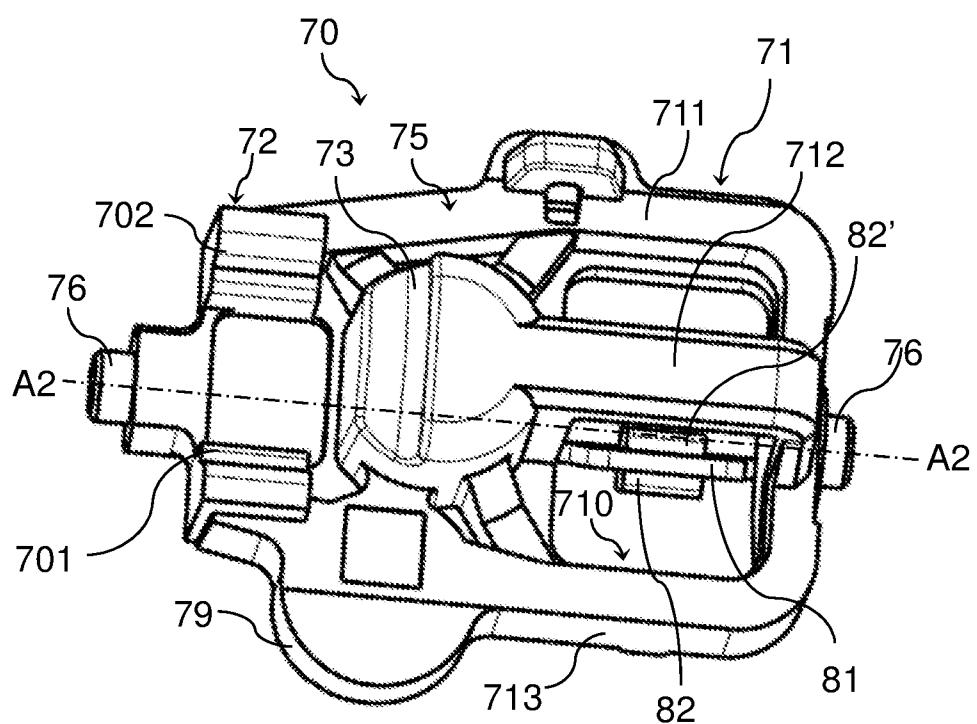


FIG. 21